TOOL & DIE JOURNAL
DESIGN, MANUFACTURE AND USE OF PRODUCTION TOOLING

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More than the ordinary methods of inspection are employed at Putnam. Here, every single end mill receives extremely rigid inspection in nearly a score of important details. They are carefully checked for hardness, clearance angles, form of flutes, quality of workmanship, and finish, and must prove perfect end mills in every respect before they are passed for shipment to you. It's final assurance that they will provide the faster cutting, longer life and better all-round performance you expect of Putnam End Mills.

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...EVEN *Work-Hardening Manganese Steels-*

present no problem to "HARDSTEEL" *Drills*

● "HARDSTEEL" drills are designed primarily for drilling hardened steels. However, the heat and abrasion resisting characteristics of "HARDSTEEL" enable it to solve many other difficult problems, such as drilling work-hardening manganese steels. On the job illustrated, that of drilling a 17% manganese steel rail, ordinary high-speed drills quickly burned when work-hardening set in, or when "hard spots" or manganese segregations were encountered. "HARDSTEEL" drills did the job easily —at an average time of 2 minutes per hole!

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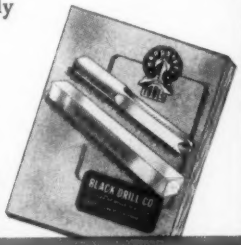

Remember — for best results **USE COOLANT WHEREVER POSSIBLE!**

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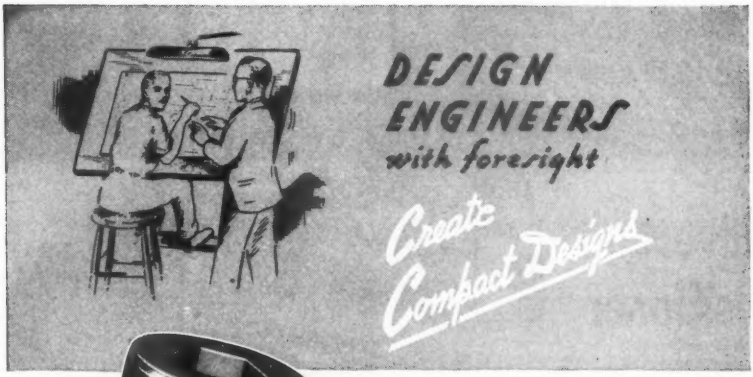

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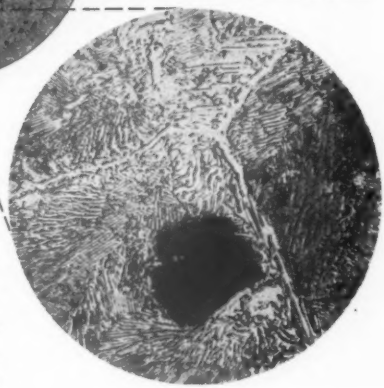
Look at the Graphite in the Grain of Timken Graphitic Steel

At Left—Photomicrograph (100x) of a tiny area of Timken Graphitic Steel showing thousands of black graphite particles in lubricant receptacles, and the white particles of wear resisting carbides.

Below—Photomicrograph (1000x) of graphite deposit at submicroscopic particle within austenitic grain.



★ In these photomicrographs you can see why Timken Graphitic Steels consistently outperform other steels in tool and die and gage applications requiring free machining qualities, high resistance to wear, and good functional qualities. In every square inch of surface there are approximately 65,000 tiny particles of free graphite precipitated from excess carbides in the grain structure.

This graphite lubricates and leaves tiny receptacles which act as reservoirs for added lubricant. This feature, combined with the well distributed, wear resisting carbides firmly imbedded in a high strength matrix, account for the remarkable service qualities of Timken Graphitic Steel.

Timken Graphitic Steel dies and tools, properly hardened, produce better formed products, free from scuffing or scoring, and in greater quantity.

Timken Graphitic Steels are first choice on countless jobs for accuracy and service in gages, dies, punches, bushings, pistons, broaches, cams, rolls, slideways, drill jigs, oil seals, mandrels, taps and a host of other uses.

Write Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio, for 48-page book - "Timken Graphitic Steels."

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Fine Alloy
STEEL AND SEAMLESS TUBES

★ YEARS AHEAD — THROUGH EXPERIENCE AND RESEARCH

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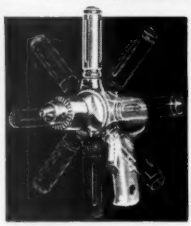

Model 7016 includes an auxiliary handle (shown in operator's left hand) that can be instantly located in any position—it revolves around the nose of the tool.

FASTER PRODUCTION

Here's big power and accuracy for heavy duty, continuous-production drilling—yet this new ARO Model 7016 Air Drill is *40% lighter in weight* than other drills of same capacity!

This big difference in weight makes the ARO ½" Drill easier to handle and greatly reduces operator fatigue. Geared for the correct speed-and-power combination in relation to its capacity—providing a capable, stall-proof answer to all jobs of drilling, reaming and countersinking.

Has ¼" pipe opening in handle . . . built-in automatic oiler . . . built-in speed regulator and safety trigger. 1000 R.P.M. ARO-built for long life and trouble-free performance. Write for catalog. The Aro Equipment Corporation, Bryan, Ohio.

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K. R. Wilson

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OF BENDING, STRAIGHTENING AND FORMING PRESS ILLUSTRATED

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Maximum Daylight	35"
Minimum Daylight	4"
Cylinder Travel Laterally	48"
Ram Speed Laterally	90"/min.
Ram Travel	7½"
Ram Speed Horizontally	15"/min.
Overall Height	100"
Overall Width	108"
Weight	3700#

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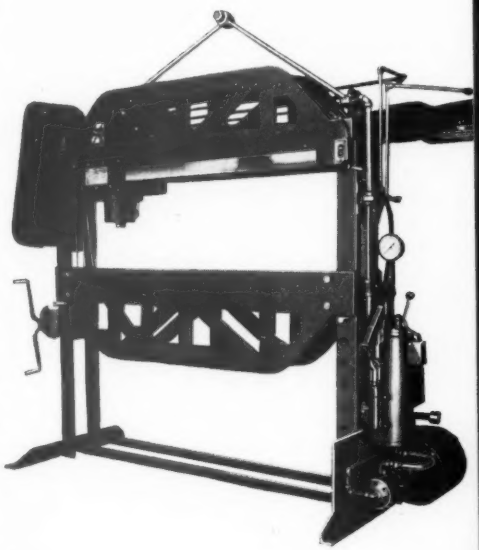

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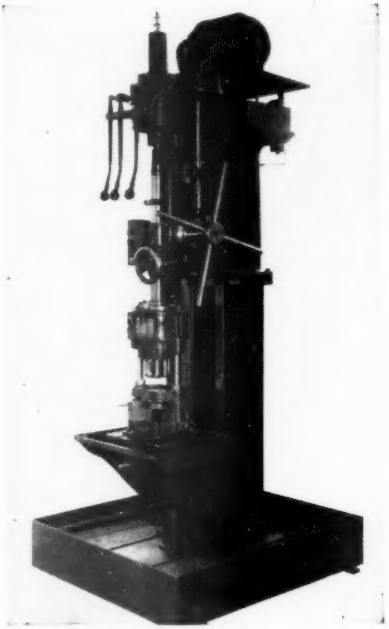

Baker Model 150 Universal Quick Change Type Heavy Duty Drill

FEATURES

1. Easily, quickly retoolable for variety of single spindle or multiple drilling.
2. Flange quill spindle construction for efficient adaptation of multiple head.
3. Twelve changes of speed.
4. Feed range from .005 to .143 per rev.
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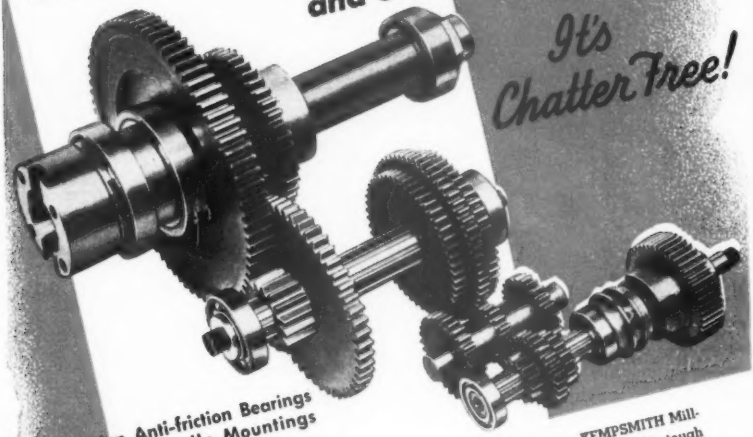
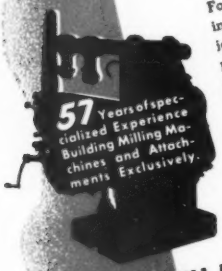


Precision Anti-friction Bearings Used for Spindle Mountings and All Gear Mountings . . .



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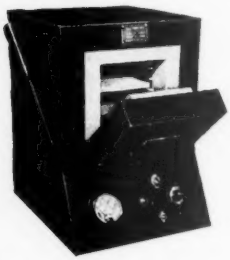

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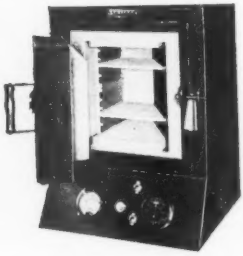
- Interior size—Model 7053 8" x 8" x 10"
- Exterior size— 18" x 20" x 24"
- Operation—110 V.A.C. or 220 V.A.C.
- Rating—3 K.W.
- Ship. Wt.— Approx. 225 lbs.



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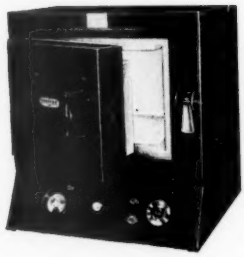
- Interior size—Model 7052 12" x 12" x 10"
- Exterior size— 22" x 22" x 24"
- Operation—220 V.A.C.
- Rating—4.8 K.W.
- Ship. Wt.— Approx. 350 lbs.



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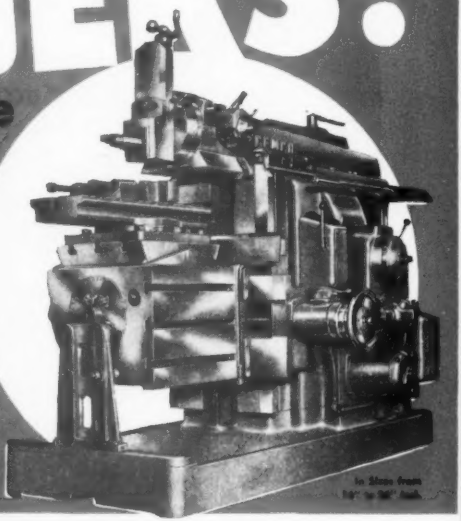

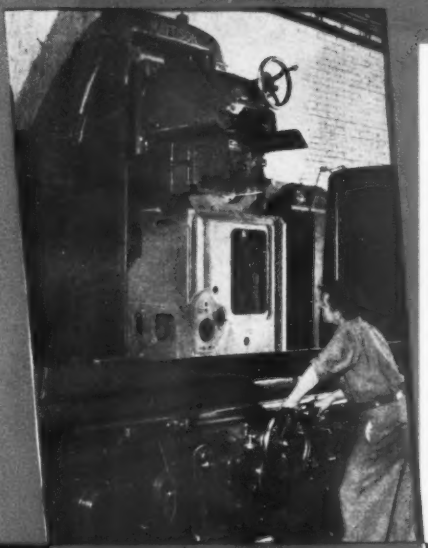

ILLUSTRATED here is only one of many dependable and efficient machine tools that contribute to the high degree of accuracy, and easy, quiet, smooth-running operation so characteristic of GEMCO Shapers.

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AMMCO

7″ SHAPER

--A precision machine

meets postwar needs for accuracy, speed and economy

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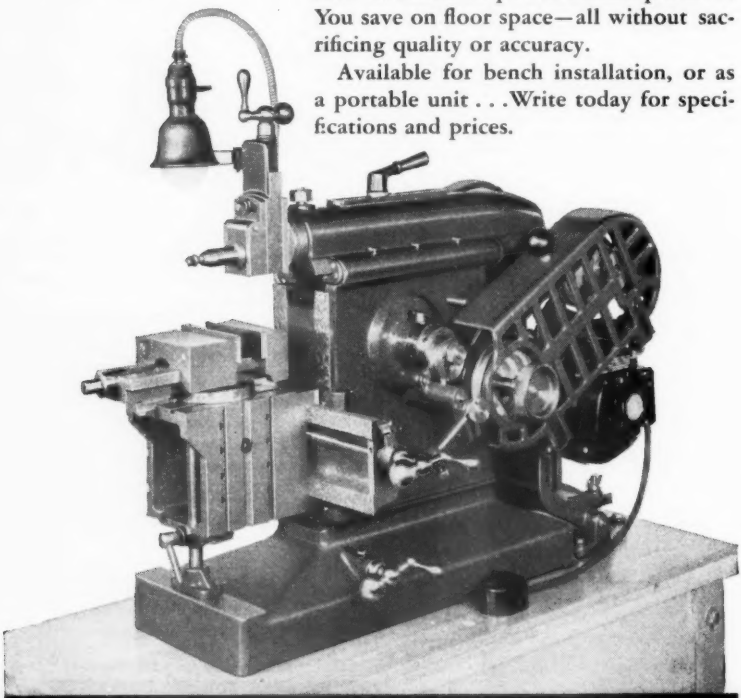
The accuracy of work turned out on an Ammco 7″ Shaper assures precision production unsurpassed by larger machines selling for hundreds of dollars more than the Ammco . . . In addition to low initial cost, you also effect big savings in time and expense on set-up operations . . . You save on electrical power consumption . . . You save on floor space—all without sacrificing quality or accuracy.

Available for bench installation, or as a portable unit . . . Write today for specifications and prices.

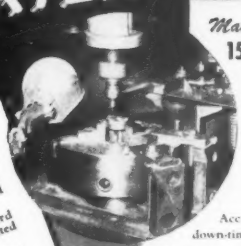


AMMCO 2100 COMMONWEALTH AVENUE NORTH CHICAGO, ILLINOIS

Injection Molds Completed

5 TIMES FASTER ON A GORTON

3-DIMENSIONAL PANTOGRAPH



JOB FACTS

NAME OF PART—Injection Mold.
MATERIAL—Tool Steel (oil hardening).
MACHINE—Gorton 3-Dimensional Engraver Model 3-L.
ATTACHMENTS—Standard three jaw chuck mounted on table.
TOOLS USED—Special Cutters ranging from .035" dia. to .340" dia.
TEMPLATE USED—2 to 1 frill shape master.
FORMER TIME—15 hours per mold.
PRESENT TIME—3 hours per mold.
ACCURACIES—All dimensions held to .0005".

Machining Time Reduced from 15 Hours to 3 Hours per Mold

ACCURACIES HELD TO .0005"

Here's an example of the type of performance you'll get on a Gorton 3-Dimensional Pantograph Engraving Machine. This large manufacturer experienced difficulty in the production of these injection molds. Time required was 15 hours per mold. Accuracies were hard to maintain. Machine down-time was excessive. Man hours were wasted.

In an effort to remedy these, the job was tooled-up on a Gorton 3-Dimensional Engraving Machine. First an enlarged master template was cut. Then, using this as a pattern, the desired molds were turned out at the correct size at the rate of one every 3 hours. The other disturbing factors were also remedied. Dimensions were held to .0005" due to Gorton pantographic reduction method. Down-time was drastically reduced. Man hours were conserved.

QUALITY WORK ON A PRODUCTION BASIS

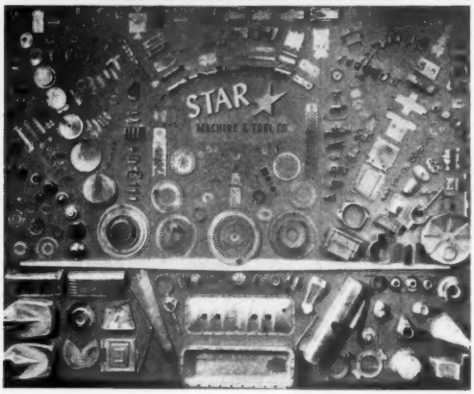
Gorton Pantograph Machines are noted for the consistency with which they turn out quality work on a production basis. They are available in both 2 and 3-dimensional models to handle many types of reproduction assignments. They can be used with high efficiency on any machinable material and their operation is extremely simple.

HOW TO PREDETERMINE THE RESULTS OF TOOLING YOUR JOB ON A GORTON PANTOGRAPH

Send detail prints or a work sample to Gorton Engineering Service at the address below. Tooling information and production estimates will be furnished promptly—no charge or obligation. You can then predetermine the possible improvement over your present methods.

GEORGE GORTON MACHINE CO.
1207 RACINE STREET RACINE, WISCONSIN, U.S.A.

FREE ADDITIONAL INFORMATION
Get the details on Gorton Pantographs and other Gorton machines by sending today for your copy of Bulletin No. 1655.



Star commenced to build dies a long time ago—way back in 1902. We've built dies of all types and sizes, in our time, including many unusual and tough jobs, and we've accumulated a degree of experience and skill in die making that, we believe, is not excelled, anywhere.

We have an unusual production department, too, operated quite independently of our tool and die shop—a department capable of starting from your blue print or sample and carrying your job through tooling to final assembly, equipped with ample facilities for the manufacture of your metal component parts or complete products in any quantity.

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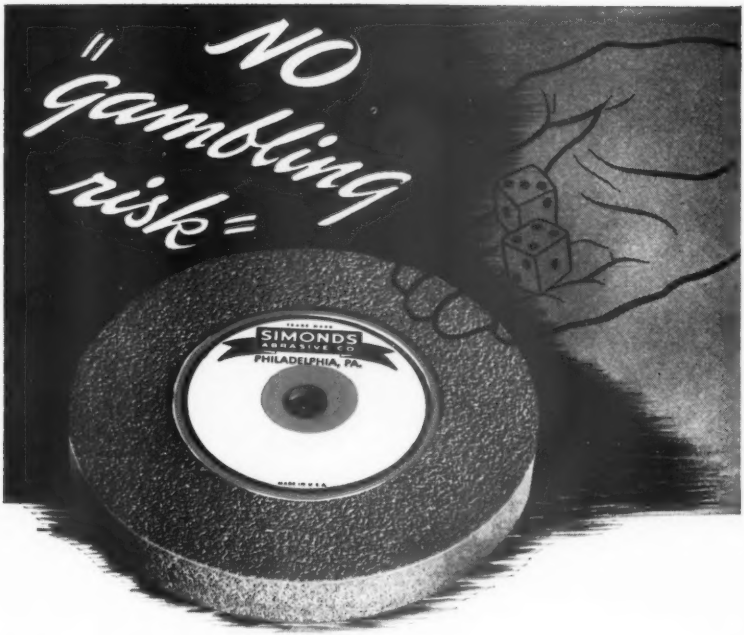

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SIMONDS ABRASIVE CO. *is a Division of*

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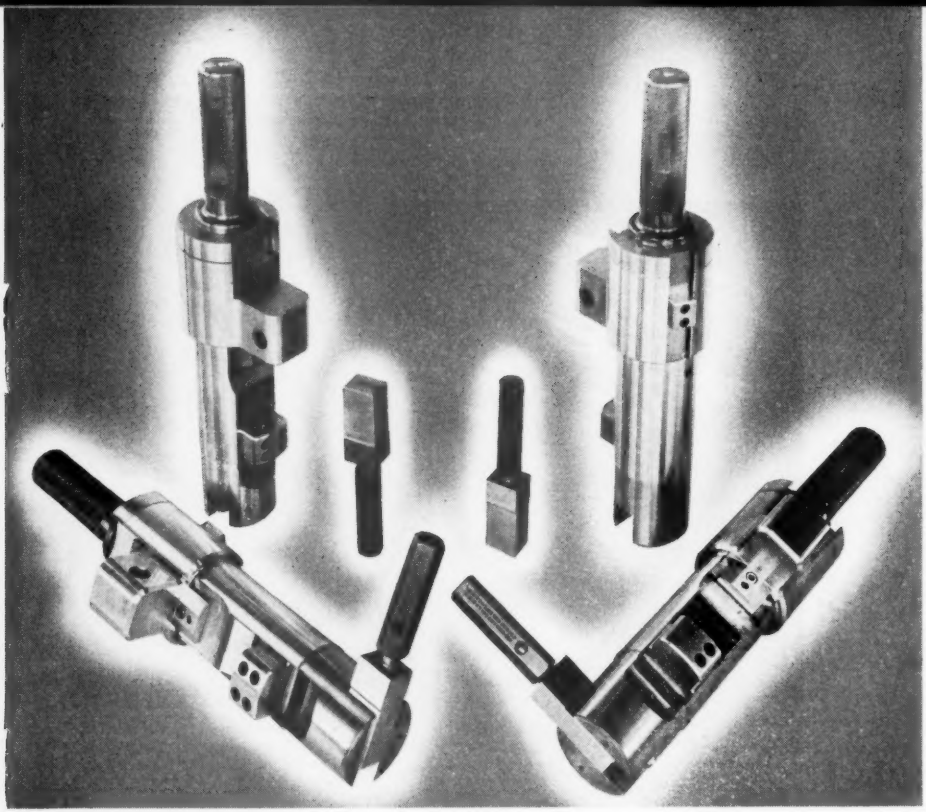

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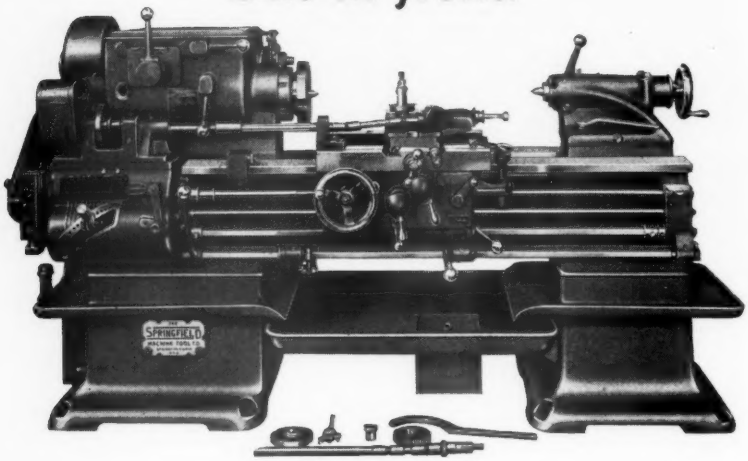

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Motors . . . V-Belt or silent chain drive.

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Apron . . . extra heavy — operates on Ball and Bronze bearings throughout.

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From headstock to tailstock—the SPRINGFIELD Lathe is *out in front!*

THE SPRINGFIELD MACHINE TOOL CO.

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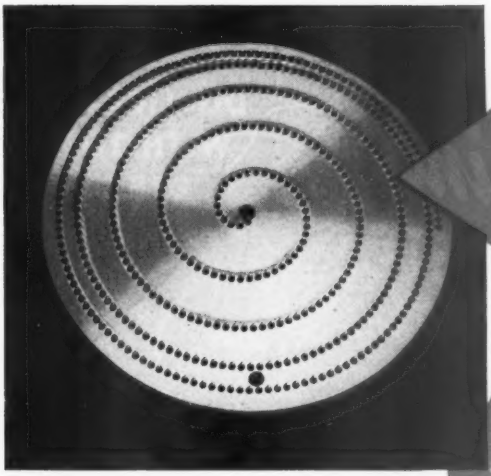

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"one of the most intricate jobs we have done" SAYS FAIRCHILD CAMERA AND INSTRUMENT CORP.

The part is a sine cam for an automatic computer, a flat aluminum disc upon which extruded gear teeth form a spiral path. A SIP Jig Borer was used for boring the 437 holes in the dies for extruding these teeth, and for boring similar holes in the gage on which the extruded work was checked.

The spiral tooth position was held to within ±.0005" in radial location and to within 30 seconds of the computed location in angular position, tolerances not accumulative.

Unusually high precision? Yes, but it is a typical example of the precision and convenience of operation of SIP Jig Boring Machines in connection with SIP Circular and Tiltable Tables. In fact, the SIP Jig Borer is one of the few existing machines capable of working to such extreme limits of accuracy. Whenever the highest precision is needed, achieve it with a SIP Jig Borer. We would be pleased to have your engineers consult with us.

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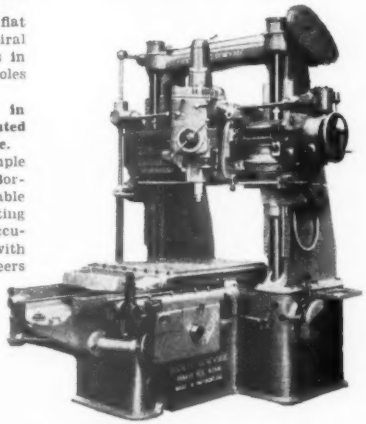
No. 2C	18" x 10¾"
No. 3K	21½" x 15"
Hydroptic-B (Illustrated)	30½" x 32"
No. 4G	27½" x 23⅝"
No. 5G	43⅜" x 32"



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METAL Stampings DUPLICATED WITHOUT DIES

With DI-ACRO Precision Machines

If you desire to save time and die expense on production of metal stampings or other small parts, then the DI-ACRO System of "Metal Duplicating Without Dies" merits your consideration. It is based on the rapid and accurate production of formed parts with DI-ACRO Shears, Brakes and Benders. All duplicated work is accurate to .001". These precision machines are adaptable to an endless variety of work, and ideally suited for use by girl operators. For short runs your parts are processed in a matter of hours instead of waiting weeks for dies.

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Di-Acro Shear squares and sizes material, cuts strips, makes slits or notches, trims duplicated stampings. Shearing width—Shear No. 1—6". Shear No. 2—9". Shear No. 3—12".

BRAKES

Di-Acro Brake forms non-stock angles, channels or "Vees." Right or left hand operation. Folding widths: Brake No. 1—6". Brake No.2—12". Brake No. 3—18".

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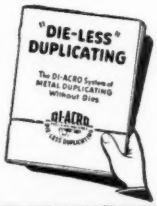
Di-Acro Bender bends angle, channel, rod, tubing, wire, moulding, strip stock, etc. Capacity—Bender No. 1—$\frac{1}{16}$" round cold rolled steel bar. Bender No. 2 and No. 3—$\frac{1}{2}$" cold rolled steel bar.

Send for Catalog "DIE-LESS DUPLICATING"

It illustrates many stampings or parts made without dies, gives full details on DI-ACRO machines and shows how they may readily be adapted for various applications. Request your copy now.



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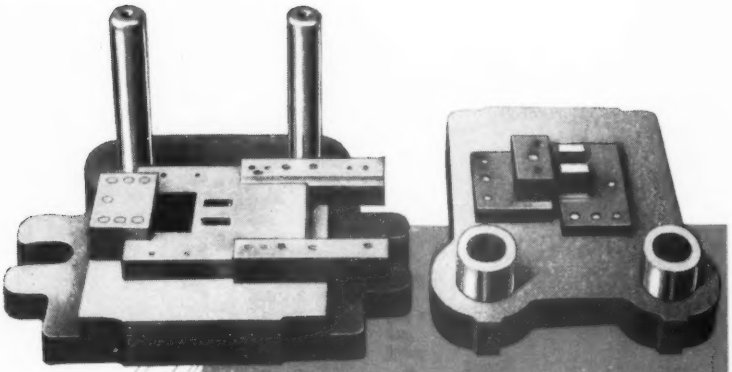

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This Cromovan Die and Punch is blanking 100,000 to 120,000 pieces of .025" silicon steel per grind . . . The original height of the die was 1¼ inches . . . now ⅝ inches high and still going, after having produced 4,500,000 pieces! For long service on high production jobs—use Cromovan Steel Dies.

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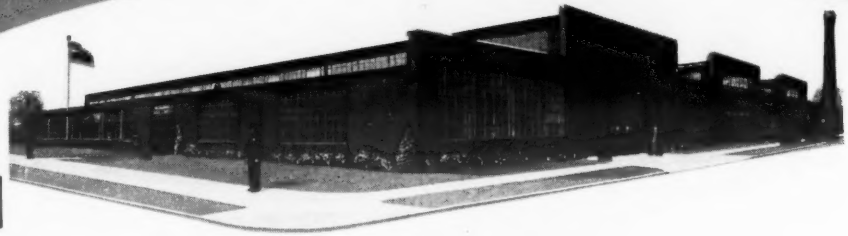

WHERE
WE FREQUENTLY MUST
"hide
our
light
under
a
bushel"

YES McKinney engineers are frequently called into secret confidence—given the outline of a manufacturing objective and authorized to take such steps as may be necessary to attain that goal.

* Then in close cooperation with the manufacturer's engineers, McKinney representatives develop and bring to practical perfection the process, method or specialized machine, as the case may be.

Having accepted this trust and carried out the assignment successfully, McKinney treats the facts in confidence, thus affording due consideration and protection to the customer in regard to the advanced methods or equipment developed for him.

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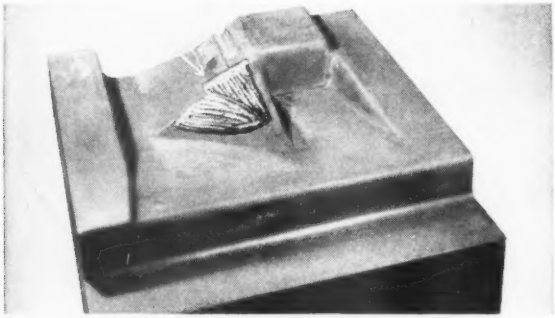
Do you know that the life of your forging dies can be extended?

Typical repair to forging die with Eureka "Drawalloy" electrodes.



Plow-share forging die refaced with Eureka "Drawalloy" electrodes.

● Save tons of forging dies and untold man-hours by eliminating resinking operations! Eureka "Drawalloy" welding electrodes do the trick by *rebuilding to original dimensions* the contours of forging dies that have heat-checked or spalled!

You can efficiently rebuild defective forging dies with "Drawalloy" electrodes and *welded deposits will match the characteristics of typical forging block steel!* Welded and adjacent areas can be machined to the original dimensions of the die! Also effectively used for die repair. Send today for full descriptive literature. No obligation.

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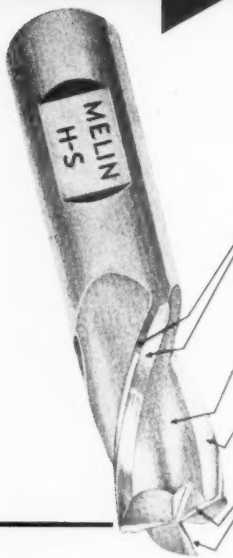

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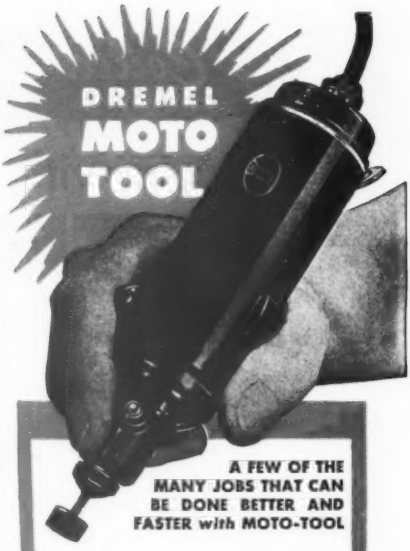

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Model 2 Moto-Tool develops 27,000 rpm . . . the proper speed for clean, smooth, accurate work, and long life from points and cutters. It is sturdily built throughout and has a shock-proof bakelite housing and oil-less (oil sealed) bearings. Uses 110-120 volt AC or DC current. Patented automatic chuck lock pin makes removal of accessories easy. Pin disengages automatically . . . prevents accidental burning out of motor. Ask your Mill Supply salesman about Dremel Moto-Tools and accessories. If his firm does not carry them, write factory or nearest Dremel representative.

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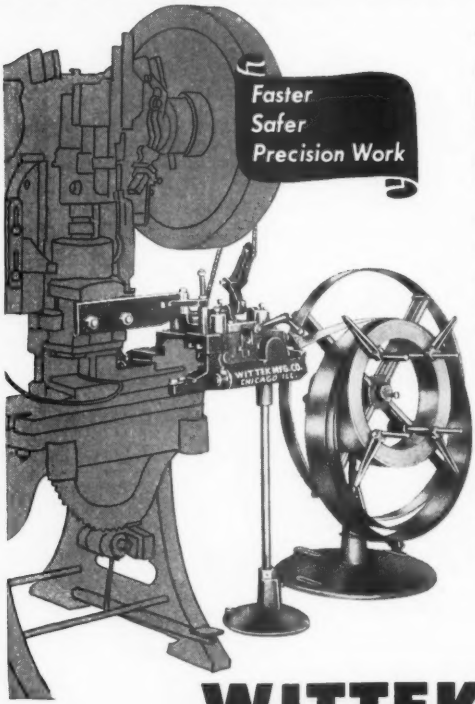

Wittek Roll Feeds are being used extensively by war plants in their large volume production of high quality metal stampings. The flexibility of Wittek Roll Feeds will assist these plants in their peacetime conversion through their adaptability to various jobs. Keen competition will demand the utilization of equipment to its point of highest efficiency. If your postwar plans include punch press production of parts from coiled strip stock—investigate now the many possibilities of Wittek Roll Feeds and Reel Stands.

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Automatic
ROLL FEEDS
AND
REEL STANDS

HERE'S THE PORTABLE SAW THAT SAVES TIME AND LABOR ON CUT-OFF JOBS

...a handy tool for you

Specifications

CAPACITY: Rectangular ..... 8" x 16"
(Special Guides) ..... 5" x 24"
ROUNDS: ..... 8" Diameter
MOTOR: .... ½ H. P., A. C. or D. C.
SPEEDS: Selective 60, 90, 130 feet per min.
WEIGHT: .... Approximately 665 pounds

All around the plant you'll see them—stock room, tool room, machine shop, maintenance dept.—wherever there is cutting to be done. Write for bulletin—or ask for a representative to call and give you the details on the low-cost Wells.

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With COLMONOY CENTER TIPS You Can

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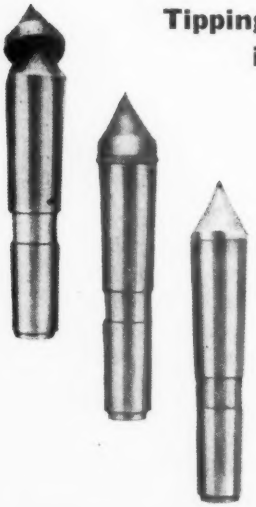

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A Colmonoy tip for a No. 4 Morse, for instance, costs only 98c.

It can be applied in 10 minutes. Only ¼ oz. of silver solder is needed.

We will furnish you the tips—or apply them for you. Write for Bulletin CT-1, giving full information as to sizes and prices.

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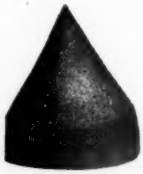
Covers the complete line of Colmonoy Hard Facing Alloys, and illustrates typical applications.



WALL COLMONOY CORPORATION

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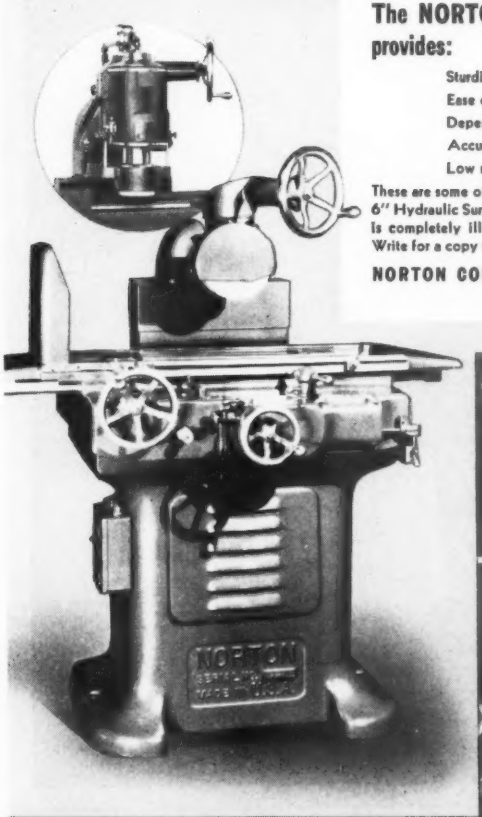
For Tool Room Surfacing

...the "Stuff" to do the job!



The NORTON 6 x 18" Surface Grinder provides:

- Sturdiness and durability
- Ease of operation and control
- Dependability of NORTON design
- Accuracy with speed
- Low maintenance and operating cost

These are some of the features that have made the Norton 6" Hydraulic Surface Grinder so outstandingly popular. It is completely illustrated and described in Catalog 954. Write for a copy today — no obligation.

NORTON COMPANY, WORCESTER 6, MASS.

M-521

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Remember, for standard applications, your CARBORUNDUM distributor can give you the right abrasive product for the job—*plus* unexcelled sales service. The next time a CARBORUNDUM distributor's representative calls, give him the opportunity to explain the benefits you obtain from dealing with this ideal source of supply for abrasives. The Carborundum Company, Niagara Falls, New York.

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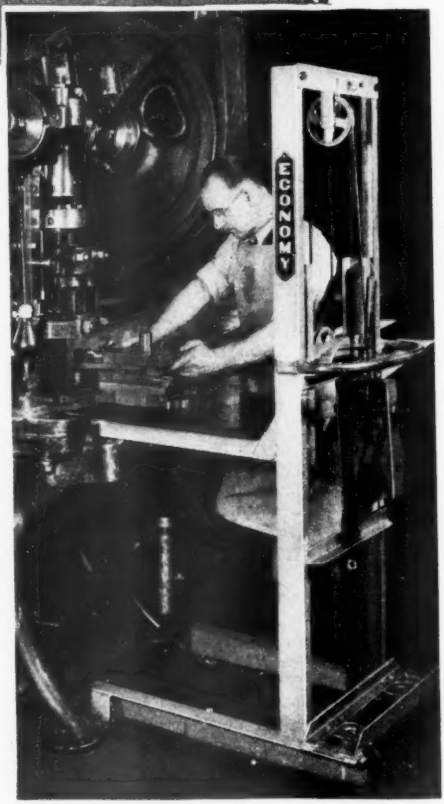
Save production time with a SHOPLIFTER



- **Light, Compact**
- **Easily Moved About**
- **One-Man Operated**
- **Wide Range in Application**
- **Saves Production Time**
  in handling dies and heavy fixtures; stacking barrels, boxes, etc.; loading and unloading trucks

Specifications

Type—D
Capacity—500 lbs.
Overall height—72"
Platform lift—54" above floor level, lowers to within 5" of floor
Baseframe—24" wide x 33" long
Platform—24" x 24", steel plate
Entire frame of machine of structural steel, electrically arc welded throughout
Basewheels—4" diameter, iron wheels
Crank up and down hoist unit
Two swivel casters and two stationary wheels with push bar furnished
Painted olive green finish
Weight—250 lbs. (approx.)

Heavier capacities up to 5,000 lbs. also available. Write for details.

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How small shops expanded grinding facilities at low cost.

How large plants reduced heavy investments.

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How a single grinder can be used on a half a dozen tool room jobs.

How plants saved by doing their own grinding instead of sub-contracting.

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How plants cut maintenance costs by handling their own service work.

How a Dumore mounts on any standard machine tool to handle many jobs.

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A HANDBOOK OF MODERN METHODS for MANAGEMENT, SHOPMEN and PRODUCTION ENGINEERS
Dumore GRINDING
CUTS PRODUCTION COST
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2. **TOOLROOM** Grinding Applications, Pages 40-58.
3. **MAINTENANCE** Grinding Applications, Pages 59-65.
4. **DESCRIPTION** of the complete Dumore line of Precision Hand Grinders, Pages 6 to 9 and 66-69.
5. **CROSS INDEX** by: Operations. Set-ups. Special Purpose Machines. Special Fixtures. Wet Grinding Operations. Materials. Indicating Devices. Protective Devices. Dressing Arrangements.

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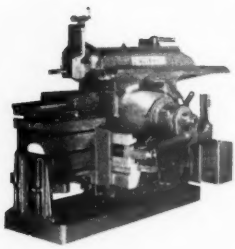

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Powerful, sturdy Cincinnati Shapers are found in these shops, for they are dependable on the tough job.

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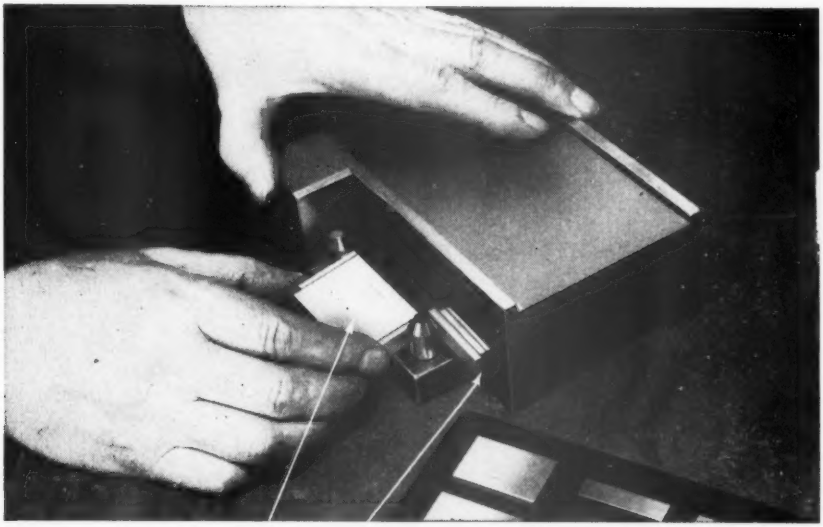

Certifying the spacing of location pins on a fixture, with two combinations of Jo-Blocks.

When the Jo-Blocks say "it's right"—then it's RIGHT!

Since the hours your engineering and tool-room staffs put into a precision fixture, jig or die can so easily represent a dead loss, if a single critical dimension is incorrect, doesn't it strike you that the use of genuine, warranted Jo-Blocks is a mighty sensible precaution?

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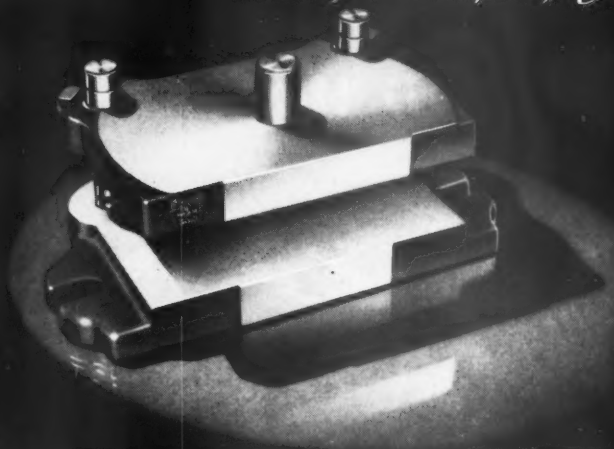

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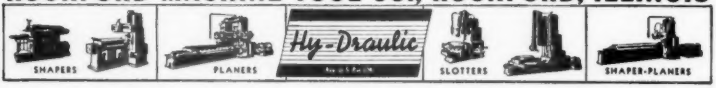

Now Air-O-chek Air Guns with Screw-On Ferrules

Patented ball and socket connection between internal lever and the valve.

Double Grip
Inside of hose held by threaded shank—outside held by serrated ferrule.

Precision machined from bar brass and stainless steel.

Easy to Install

Just trim hose square. Slip ferrule over the end, insert Air-O-Chek and screw up.

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Now AIR-O-CHEKS offer the advantage of convenient assembly direct to the hose without special tools. You just slip the new Screw-On Ferrule over the hose, insert the AIR-O-CHEK shank and screw up. The assembly is streamlined—free from protruding clamps or screws. No costly equipment used in contracting or expanding ferrules is required. You can attach the AIR-O-CHEK on the job using only wrenches.

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Famous for versatility, South Bend Precision Lathes bring peak efficiency to shops where frequent changes of set-up are called for and a variety of materials are used. And their modern design, with convenient controls and full quick change gear equipment, means less fatigue and less "machine scrap" due to such causes.

If your shop problem is to increase efficiency, it will pay to consider the installation of South Bend Precision Lathes when new equipment is added, or present equipment is replaced.

Send For Catalog

Catalog 100-D shows in color all sizes and models of South Bend Toolroom, Turret, and Engine Lathes. Made in 9", 10", 13", 14-1/2", and 16" swings. Accessories and attachments shown.

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Industry Acclaims the WORLD'S FASTEST VISE

Purchasers of "Grip-Master" are doubling and tripling their original orders!

Look at These Revolutionary EXCLUSIVE FEATURES

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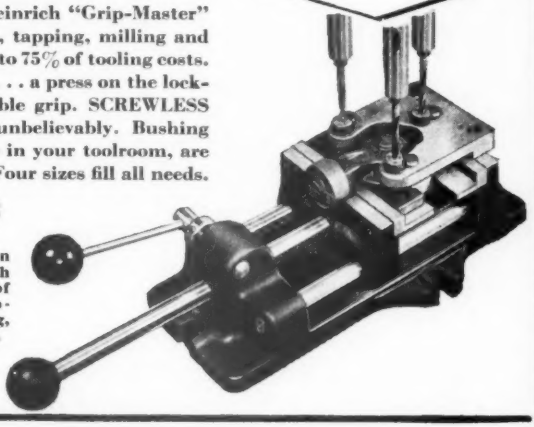
Grip-Master

DRILL PRESS TYPE
SCREWLESS VISE

CUTS JIG AND FIXTURE COSTS 75% SPEEDS PRODUCTION

Engineers incorporating the Heinrich "Grip-Master" in jigs and fixtures for drilling, tapping, milling and assembling operations save up to 75% of tooling costs. A push on the center bar knob . . . a press on the locking lever, gives fast, unbreakable grip. SCREWLESS feature cuts operating time unbelievably. Bushing plates and locating jaws, made in your toolroom, are easily attached to cast bosses. Four sizes fill all needs.

An example of how "Grip-Master" is used in drilling jig and fixture design.



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A postal card brings an illustrated folder with complete details of Heinrich "Grip-Master's" amazing, cost-cutting features.

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Saves set up and re-leveling time

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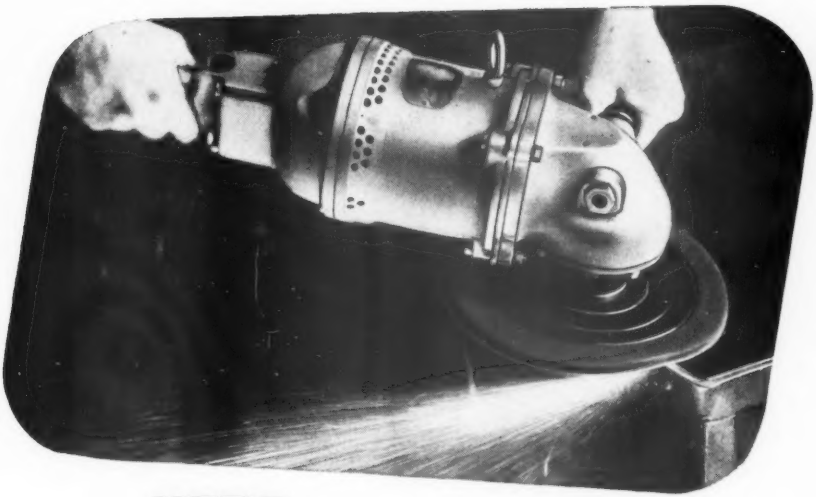

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For better, faster finishing there are *specialized* ARMOUR ABRASIVES designed to do a *better job at less cost.* The faster, sharper, cooler-cutting *Armourclad Fibre Combination Disc* is only one of Armour's *complete* line of better metal-working abrasives.

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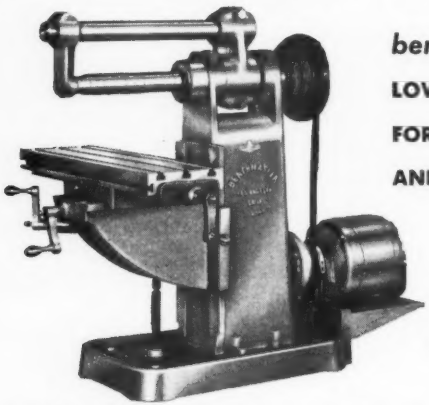

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SAVES VALUABLE SPACE—CUTS DOWN EQUIPMENT COSTS

Now you can obtain a precision perfect, high-speed *benchmaster* milling machine that's easily convertible from a horizontal to a vertical miller by simply interchanging spindle attachments. Its *un*usual versatility, plus the *usual* quality-plus *benchmaster* workmanship, make this double-duty milling machine an outstanding addition to your shop.

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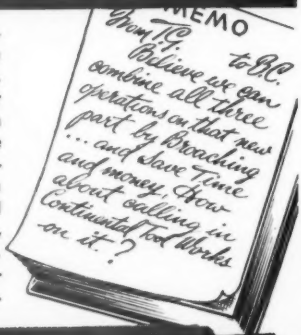

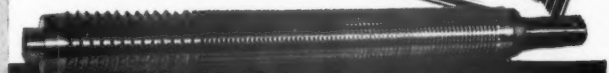

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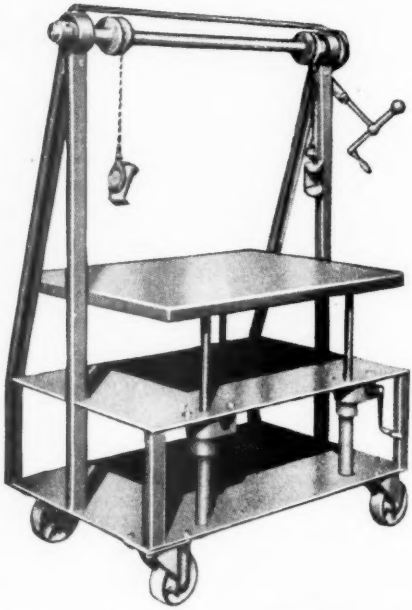

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1. Makes die separation and assembly a simple, one-man job.
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4. All gears are accurately machined and fully enclosed.
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7. Rolls easily on heavy-duty ball bearing casters.

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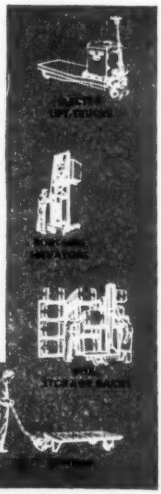

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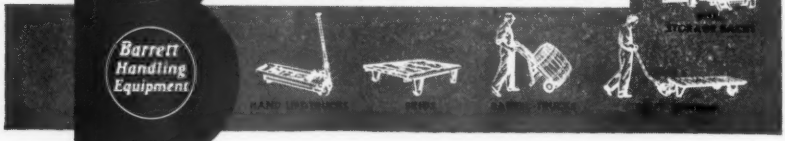

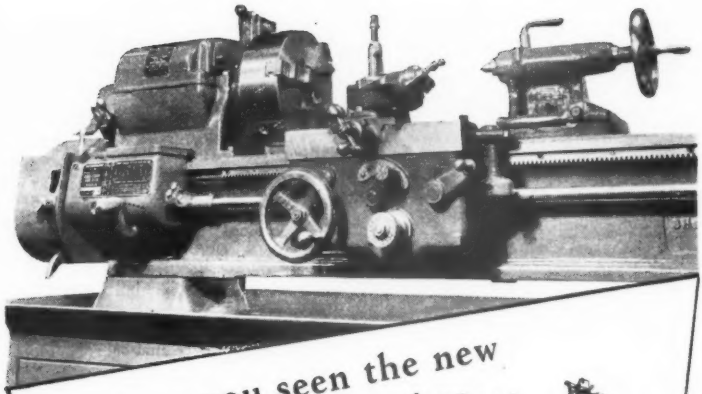

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From any angle a better lathe.

. . . those built in the new SHELDON machine tool plant? Always good lathes, these new SHELDONS are even better, not only in design refinements but in extreme accuracy, greater work capacity for size, "sweeter" handling and actual beauty of finish. Only a set-up like the new SHELDON plant could build such lathes—a specially designed building, the most modern manufacturing methods, complete tooling with row on row of the finest, most modern manufacturing equipment.

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Check the five distinctive features of MO-MAX. Then order a sample lot from one of the mills listed here.

ONLY MO-MAX GIVES YOU *all* THESE ADVANTAGES

1. MO-MAX has superior cutting qualities. It is a happy combination of great toughness with high hardness.
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"BETHLEHEM HM"	Bethlehem Steel Co.
"MO-CUT"	Braeburn Alloy Steel Corp.
"STAR MAX"	Carpenter Steel Company
"MOLITE M-1"	Columbia Tool Steel Co.
"REX T-MO"	Crucible Steel Co. of America
"DI-MOL"	Henry Disston & Sons, Inc.
"HI-MO"	Firth-Sterling Steel Company
"REX T-MO"	Halcomb Steel Company
"MOGUL"	Jessop Steel Company
"TATMO"	Latrobe Electric Steel Co.
	St. Lawrence Alloys, Inc.
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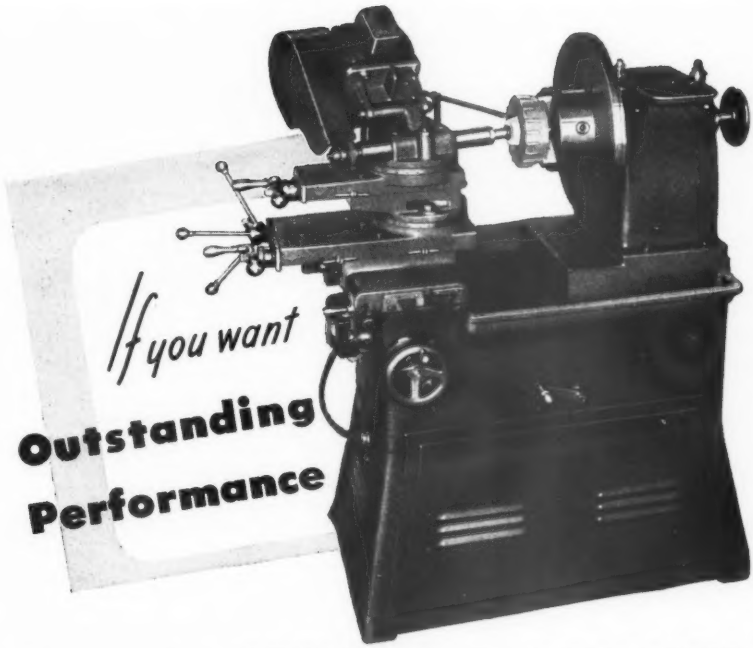

you want a LEMPCO ACX GRINDER

Here are the facts that enable the Lempco ACX Multi-Purpose Grinder to out-perform any similar machine in its price class.

Lempco's patented auto sizer enables piece after piece to be accurately ground to identical size without losing valuable man hours for redressing wheel. Two-to-one ratio makes rack and pinion feed fast and accurately. With the ACX many operations can be done without changing set-up. Chucks are mounted or demounted on face plate quickly by means of a single draw bar through the hollow spindle.

The Lempco ACX Grinder offers other money-saving features. These are listed below. They mean fast, low cost production in your tool room or on your production line.

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6. Face Grinds and Turns.
7. Automatic Power Cross Feed.
8. Wide Range of Adaptability.
9. A single set-up will allow for two or more operations, guaranteeing greater accuracy of the piece being machined.
10. Self-contained direct motor drive to coolant pump assures adequate supply of coolant from 10-gallon tank. Flow is adjusted by valve at nozzle.

HOW TO GET A BETTER GRIP

on efficiency in cutting

In Cooper-Bessemer's newly developed tool holders, the patented device shown above takes a man-sized, two-way grip on bits and blades, so that they can't possibly slip, twist, or *chatter!* You know what *that* means! Heavier cuts with higher speed and feed . . . finer, cleaner work . . . better precision. In short it is a sure way to get a much better grip on metal-cutting efficiency!

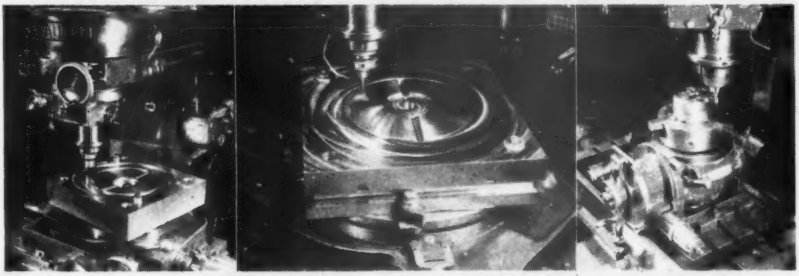
This is only one of several big advantages you gain with these unique Cooper-Bessemer holders. Send for free Bulletin 102-TH. It tells the *whole* story in very few words and also gives dimensions, specifications and prices covering all our standard turning and cut-off holders for both engine and turret lathes.

THE Cooper-Bessemer CORPORATION
Industrial Tool Division
Dept. J, Mount Vernon, Ohio

COOPER-BESSEMERS CUT THE COST OF CUTTING

Shortcut to Production

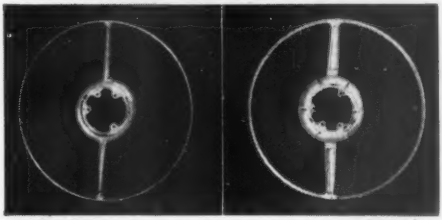
KEARNEY & TRECKER ROTARY HEAD MILLER COMPLETES COMPLEX 3 PART DIE DIRECT FROM BLUEPRINT TO WORKPIECE NO TEMPLETS OR MODELS REQUIRED



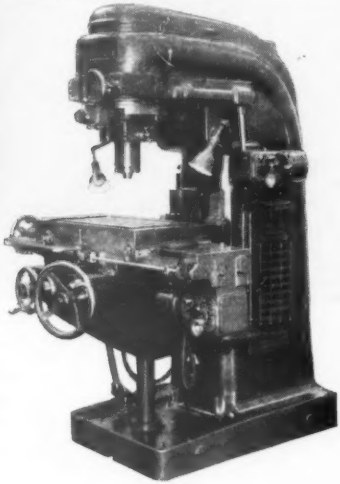
1. Shows set-up of completed ejector half of die. Operations on die face completed in single set-up. Total set-up and machining time — 69.4 hours.

2. Set-up for cover half of die. Operations on die face completed in single set-up. Total set-up and machining time — 74.2 hours.

3. Set-up for machining center insert part of die. Note deep narrow slots — end milled. Operations on die face completed in single set-up. Total time for set-up and machining — 86.2 hours.



Both sides of the finished horn ring for an automobile steering wheel — as it comes complete from the die being machined above.



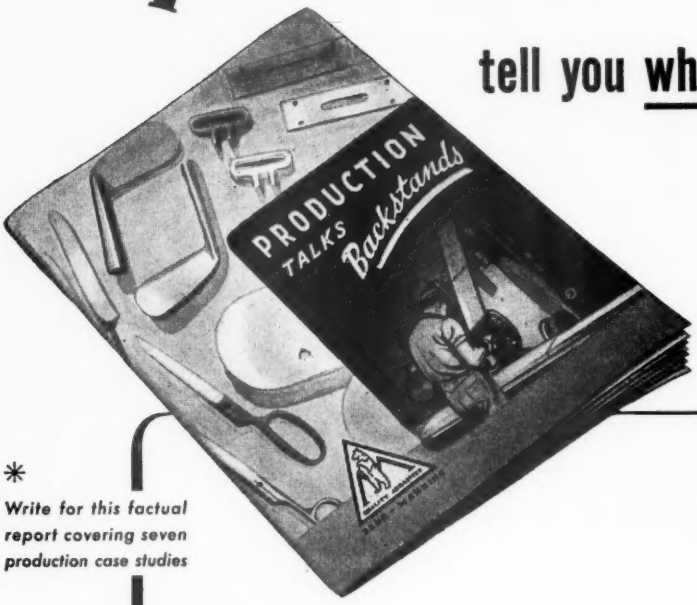
DIRECT — ACCURATE — FAST — are the three factors that make the Kearney & Trecker Rotary Head Milling Machine so outstanding for toolroom, experimental, and manufacturing work. DIRECT—because it mills intricate shapes in a single set-up, transmitting blueprint dimensions direct to the workpiece without the aid of models or templets. ACCURATE—because there is exact control of all mechanical movements. FAST — because initial preparation and multiple set-ups are eliminated.

For complete information write for Catalog 1002C. Please give your business connection.

Kearney & Trecker
CORPORATION
MILWAUKEE 14, WISCONSIN

7 Field Engineers

tell you why*



Write for this factual report covering seven production case studies

Easily the greatest current development in coated abrasive engineering is the conversion of grinding and finishing methods from shop-coated set-up wheels to factory-coated abrasive belts through the use of idler backstands and cushioned work wheels. Truly, "production talks backstands"!

Here is a booklet for production men that answers the question, "Can backstands boost our production, too?" Factually written from field engineers' case reports on backstand installations in seven diversified industries, it permits accurate appraisal of backstand adaptability by direct comparison.

Production men recognizing comparable backstand operations in this booklet may rightly expect equivalent success with backstands in their own plants.

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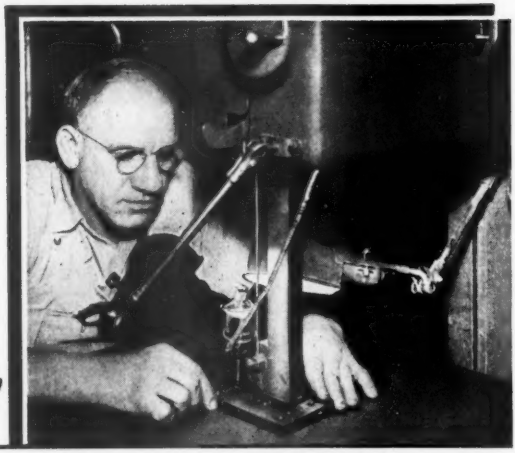
BAND SAW BLADES

for Smoother



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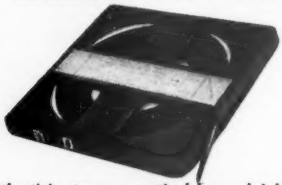
ATLANTIC SAWS meet all of your requirements for a superior blade on complicated die and fixture radius cutting. ATLANTIC specializes in accurate milled and precision set teeth, hardened to exact temper.



Atlantic's strong, practical box, plainly marked on sides and top. Remains in good condition until entire coil is used.

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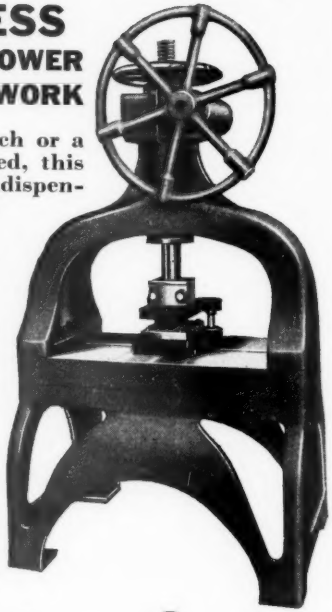

Whether the lightest touch or a 50-ton pressure is required, this modern screw press is indispensable for the countless press jobs that confront busy tool and die rooms.

You will find it efficient for shearing, assembling and lining Punches and Dies, and for separating Punch and Die Holders on large Liner Pin Die Sets. The 3″ hole in the bed allows it to be used for short broaching operations and for disassembling spindles or shafts from press fits in bearings.

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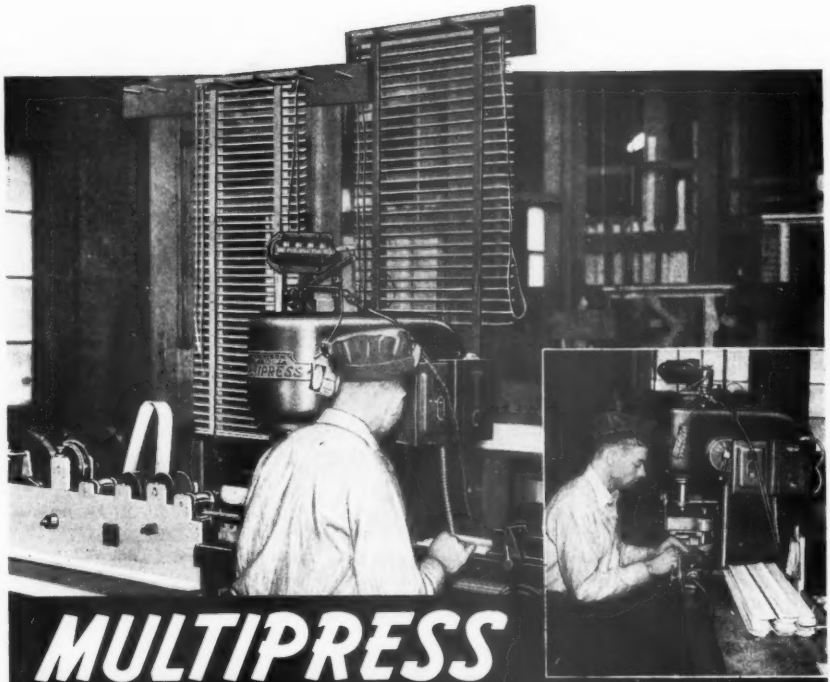

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EQUIPMENT for APPLIED
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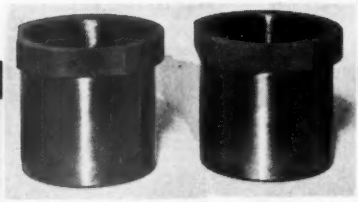

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Lapping and other methods of honing failed to produce a hole without excessive bell-mouth, usually .004" to .005".

The stock is water hardened steel with a C scale Rockwell of 65. Hole finished diameter is 2.375" — plus .0003", minus zero.

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Hydraulic Two-Way Control Valve. Hole is honed to eliminate leakage.

Carburetor Idler Valve Jet. Hole is honed after reaming for smooth action.

139

PRECISION REID SURFACE GRINDERS

CONTROLS

"At your fingertips"

It's a RARE *occasion*

WHEN REPLACEMENT PARTS ARE NECESSARY FOR REID *PRECISION* SURFACE GRINDERS. ● MOVING PARTS ARE MOUNTED IN TIMKEN TAPERED ROLLER BEARINGS, BALL-BEARINGS AND OILITE BUSHINGS. ● ALL SHAFTS ARE HARDENED AND GROUND. ● EFFICIENT, SIMPLIFIED, LUBRICATION. ● THESE IMPORTANT FEATURES ASSURE YOU EXCEPTIONAL PRECISION RESULTS, EXTRA LONG WEARING QUALITIES, AND EASE OF OPERATION WITH CONTROLS *"AT YOUR FINGERTIPS"*.

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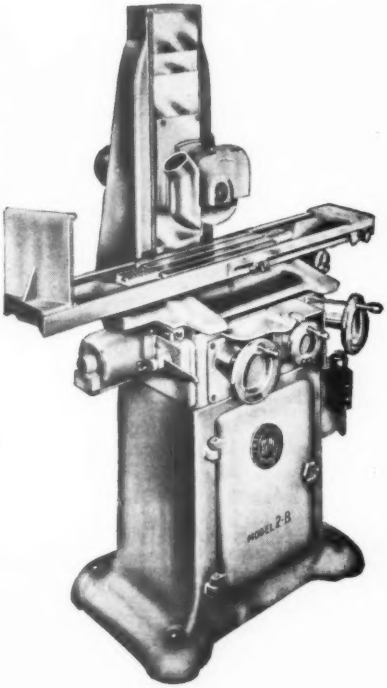

Illustrated is the REID Model 2-B All-Electric Power-Feed.

The Reid Model 2-C Hand-Feed also is an exceptional machine for tool, gage, die and certain production grinding.

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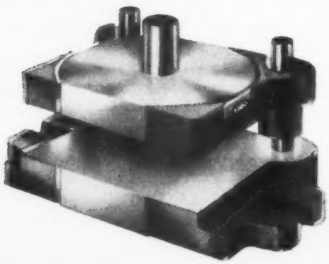

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GROUND FINISH

Accurate to .002" from Flat

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6 x 6 x 6	17 Lbs.	1 Rib	12.25
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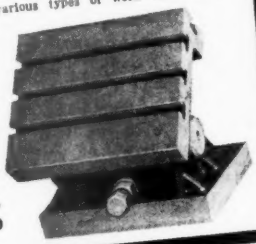

These Angle Plates are made of the best grade of gray iron, machined and ground true with the holes, all steel parts are hardened and ground. MODEL "A" has four ⅜" "T" SLOTS, 3 on the face side and one "T" Slot on the top when set at 90°. The size of this plate is 3 x 3 x 3¾. Shipping weight 5 lbs.

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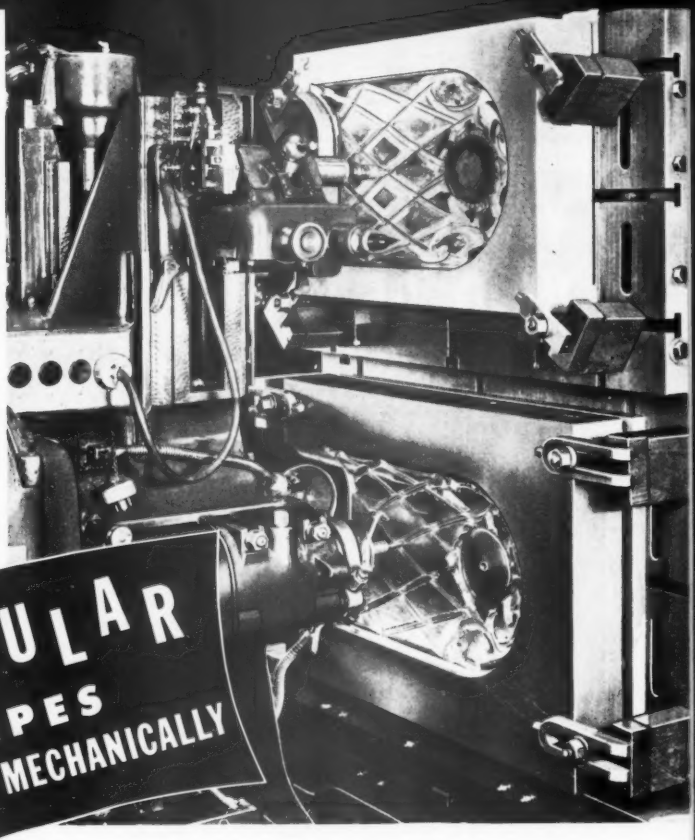

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DOING A BETTER AND QUICKER JOB of duplicating irregular shaped objects that cannot be machined round or straight is an important part of Barth's service to industry.

With the Keller Duplicator pictured above (in the process of duplicating a Wurlitzer juke box cover), a cast of the object to be duplicated is fastened above the work.

The tracer points are actuated by electrical contacts and operate the three movements of the profiling machine: the milling cutters faithfully follow the same path as the tracer points and exactly reproduce the shape on the work below.

• • •

As well as duplicating irregular shapes, the Barth Organization offers you complete tooling, die, special machinery and designing service.

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DIES · TOOLS · GAUGES · JIGS
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This is a rigid, high-speed unit embodying all of the features essential to modern milling practices. Popular demand has made it a standard item which thousands of tool and die makers, and production plants find a practical necessity.

Ten chances to one there's a spot for one of these productive machine tools in your shop.

It is probable, too, that we have the answer to some particular production problems hampering *your* cost control.

Let us send an S and A engineer to discuss it with you.

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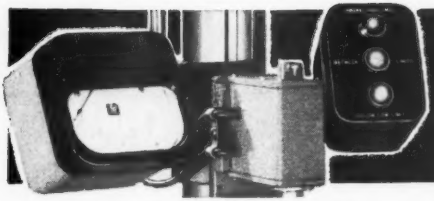

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It has a choice of four differently graduated scales. You are not limited to a single scale. You can read any value from .000010" to .003". Minimum contact pressure is only 1½ ozs.

Any operator can use it. He can't hurt it by forcing the contact spindle.

It is adaptable to various set-ups on any machine or gaging fixture.

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PRECISION MEASURING INSTRUMENTS

tooling for photography

If, during the summer vacation season, the editor of a tooling and production publication should venture to editorialize on the technicalities of magnesium golf club heads or stainless steel tubing for fly-casting rods, he would risk being accused of having his mind more on his hobby than on his work.

In an attempt to avoid appearing, for even a short exposure, in such a questionable light, we wish to develop the idea that in the photographic world, precision camera manufacture embodies the utmost in expensive and ingenious tooling per ounce, pound or dollar of finished product. To help dispel any negative reaction to that premise, we are preparing a feature story covering the unique tooling and production involved in camera manufacture.

Many phases of precision manufacture contribute to a quality camera of pleasing design and operation: accurate die casting of light metal alloy chassis; press operations on phosphor-bronze stock so thin that shutter and diaphragm leaf flanks cannot be handled for de-burring, hence there can be no burrs; v-slides, cut pinions and racks, and cam mechanisms so free of slack and backlash as to be velvet-smooth in operation; and withall the design must decree rugged construction of long and trouble-free operation.

The problems attendant upon these tooling and production programs account, in part, for the seemingly interminable delay in the appearance of new cameras in dealers' windows. They also combine with the war-interrupted production and the cessation of optical goods imports to shape up a new user and replacement market of unprecedented proportions.

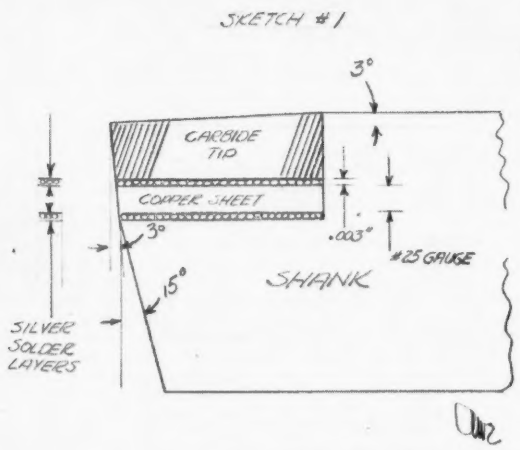
In fact, we are so anxious to get hands on new camera equipment that an adverse factor is looming up, i.e., this lush market is attracting some, designers and manufacturers alike, who apparently have no justifiable place in the picture.

For the experienced and discriminating photographic worker, professional or hobbyist, there must be just as much proper fit and feel built into a fine camera as is in the violin of the concert artist or the special gun-stock for the expert rifleman. Some of the currently projected designs are as far removed in time-proved qualifications and acceptable operating characteristics as open plumbing with a fringe on top. As in other fields, postwar cameras will collectively be launched on a shake-down cruise and it will be a case of the survival of the fittest.

Many photographic accessories utilize interesting production procedures. Tanks for daylight development involve deep-drawing or spinning of the stainless and chemical resistant alloys to close tolerances. Daylight development means that after loading those 4th of July negatives in the tank, development can proceed automatically while one is otherwise occupied in writing an editorial or * * * *what am I saying!*

E. Willard Pennington

editor



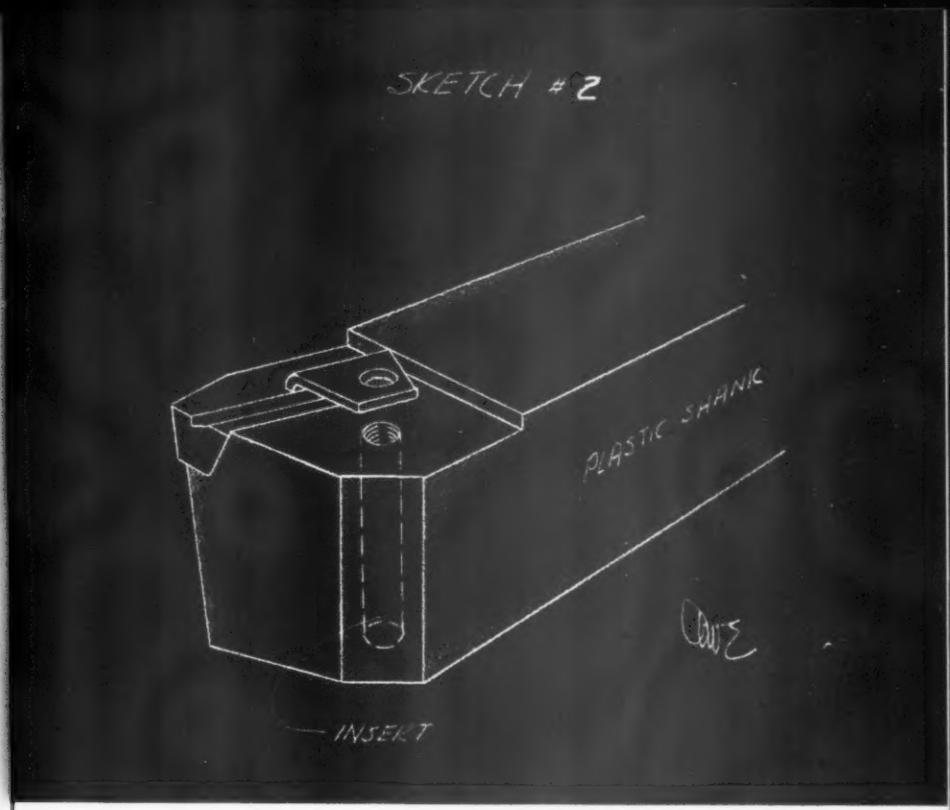
The copper sandwich braze was effective in partially dampening vibrations and prevented excessive tip failure.

CUSHIONS FOR CARBIDES

Experimental developments, through trial and error, in a new approach to carbide-tipped tool design show promise of overcoming tip-shattering vibrations.

Many articles have been written expounding the use of negative relief angles on carbide-tipped cutting tools. Also, many articles have been written on the various methods of "cushion brazing" the carbide tips to tool shanks.

The writer has found, by trial and error methods using actual records of tool life between grinds, that a very definite relationship must exist between the negative relief and the cushion braze if exceptional tool life is to be expected.



The plastic tool shank of generous cross section for roughing cuts demonstrated surprising tip life with little or no cracking in operation.

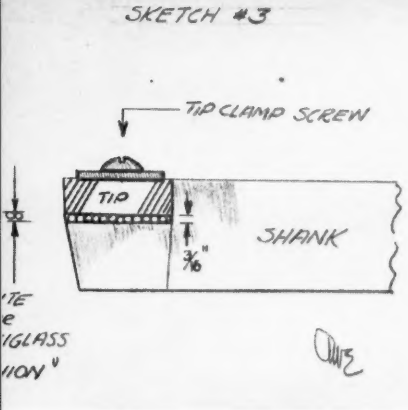
by A. W. Ehlers
Contributing Editor

Vibration, Source of Trouble

In most cases, the problem to overcome is that of vibration or certain periods of vibration which, by assisting flaking or crumbling, tend to destroy the cutting edge of the brittle carbide tip. This is especially true when the new, very hard grades are used on cast irons which have been heat treated to the range of 460 Brinell. Carboloy 905 and 999 are typical examples of the grades which have proved very successful on this type of cast iron. While these grades have good qualities as to resisting cratering by chip abrasion they are also exceptionally brittle at the cutting edge, even though the cutting edge is bolstered by the use of negative relief angles. The cutting edges fracture when encountering excessive casting irregularities and heavy scale if the carbide tips are not "cushioned" correctly.

Conventional Type of Braze

The writer's first attempts at cushioning the tip employed the conventional ribbon type of copper braze. However,



For finishing cuts, the combination of a metal shank, mechanical clamp and plastic cushion ran exceptionally well, with very little chipping of the hard carbides.

when the copper sandwich "froze" after cooling, the cushion thickness was found to not exceed .005" because the copper flows as a very thin film along the fluxed surfaces of the tip and tool shank.

As a hydrogen or other controlled atmosphere is necessary, at the approximately 2000° F melting temperature of the copper, to keep down excessive oxidation of both the shank and the copper, this method of tipping is not practical except in the case where an electric, controlled atmosphere furnace is available. Also, at this temperature, the nickel-chrome alloy muffles have a very short life.

The thin copper cushion, effected by the copper braze, did not succeed very well in dampening heavy shank vibrations. Results, however, seemed to indicate that the copper braze reduced the cooling strains existing between the shank and the tip in comparison with a straight silver solder braze.

Application of Sandwich Braze

A further attempt to dampen tip vibration employed the use of the sandwich braze. This method employs the use of a piece of 25 gauge copper sheet cut to the profile of the shank recess. Both sides of the copper insert are fluxed by heating the insert in a welding torch flame to "dark" heat and then plunging the strip into silver solder flux. With a pair of fine-nosed pliers, this sheet or sandwich is inserted between the tip and the shank recess and then the regular silver soldering technique is followed. As most silver solders melt well under 1200° F, the copper strip remains intact and becomes a link between the tip and the shank being connected by the two layers of silver solder.

This type of sandwich braze adapts itself very easily to the recently perfected high frequency brazing techniques. Here, the copper strip is placed between two layers of silver solder sheet, all cut to the proper profile, and the entire assembly is dipped into flux and then inserted between the tip and shank prior to placing the tool in the induction ring.

The sandwich type braze proved much more successful than the previous brazes of melting copper and silver solder. Shank vibrations were partially dampened and prevented excessive tip failure due to chipping. The cushion now averaged .027" in thickness and the nature of the braze itself tended to reduce cooling strains between the shank and the tip. Tip failures, however, still continued in both tool grinding and actual service in the shop and when a complicated grooving or forming tool was involved, many expensive hours of work were lost.

Sketch No. 1 shows a typical sandwich braze.

Mechanically Clamped Carbide Tips

Experiments were also conducted with mechanical clamping of the carbide tips, using the top clamp as a chip breaker, but, as this type of tip holding was not cushioned, the results on the hard cast irons were not too satisfactory. This adaptation was also limited to the straight turning and facing tools as the mechanical clamp presented a problem of interference. A thin sheet of 25 gauge copper inserted between the tip and the shank helped the situation as to crumbling of the cutting edge but failures were experienced by the entire tip cracking at right angles to the cutting pressure or parallel to the mechanical clamp.

The new, specially grooved tips and

holders developed by Kennametal are especially adapted to the clamping technique.

The Plastic Tool Shank

The writer began to theorize that if the shank vibration itself appeared to be the root of the trouble, why not attempt to dampen the shank vibration at its source rather than at the tip? The use of clamped-on tips certainly removed the necessity of brazing the simple turning and facing tools necessary for roughing cuts. Therefore, the shank need not be of metal with its inherent tendency to transmit machine and tool vibration. It might, instead, simply be a tough material possessing a low period of vibration and capable of withstanding heavy vertical tool pressures and having also the ability to resist the taking of a permanent set. These requisites seemed to indicate a plastic.

As several shapes of the DuPont plastic trademarked "Lucite", a methyl methacrylate resin, were available it was selected for the initial trial. The cast Lucite has a tensile strength of 6000-10,000 psi and a modulus of elasticity in tension of 3-5 x 10^5 psi. While this material does not approach metallic shanks in physical characteristics it is, however, as strong a plastic as is now commercially available. Exceptions to this last statement are of course to be expected from new developments during the war period. The Rohm & Haas "Crystalite" is a plastic very similar to DuPont "Lucite".

Plastic Shanks for Roughing

It was found that if a tool shank of one inch square cross section of ¾" x 1½" cross section was used, it had sufficient bulk or "beef" to withstand the pressures developed by a .011" feed at 180 sfm with a stock removal of .125" on the hard cast irons. Tools of these cross sectional areas are commonly used on such machines as Model 10 Sundstrands and 12" Fay Automatics. The overhang of the tool should be held as closely as possible to the minimum, with special tool block "under-supports". To prevent the hold-down screws in the tool block from marring the plastic shank surface, sheet metal top shims are used. To prevent thread stripping in the plastic tool shank by the mechanical clamp hold-down screw, a threaded insert is used.

Sketch No. 2 embodies the features just described.

The plastic tool shank demonstrated excellent potentials as to carbide tip tool life on roughing cuts inasmuch as the total deflection of the shank resulted in out-of-round variables of from .002" to .004" on 6" OD's in cast iron. Tip life was exceptional, with little or no cracking being experienced in operation. Because the required cross section of the shank limits its usefulness to a narrow field of tooling and because the deflection variables as noted precluded its use in finishing cuts, the writer attempted another application.

Plastic Cushions for Finishing

Smaller tools, using the conventional mechanical clamping techniques and metallic shanks, were put into service with a cushion of ⅛" thick "Lucite" or "Plexiglas" sheet cut in the same manner as the copper sandwich. These tools ran exceptionally well in heavy service with very little chipping of the hard carbides. Sketch No. 3 details a mechanical clamp and plastic cushion.

Future Trends

As development continues in the plastics field and the present bonding resins are improved, the writer feels that the near future may well see carbide tips cushioned with plastic inserts and bonded to metallic shanks. Also, we may see plastic milling cutter bodies with resin bonded carbide tips that will absorb cutter tooth vibration to such an extent that deep cuts and fine finishes may be accomplished without resorting to heavy milling machines and spindle flywheels. This should be especially true in machining the light metals such as aluminum and magnesium.

It is the writer's hope that the favorable results reported here may encourage further experimentation, exchange of information and progress reports.

"PRESS-WELDING" ALUMINUM FINS

German wartime output of aircraft radiators was accelerated by a technique referred to as the "press-welding" of aluminum sheet.

After the war, T. G. Haertel of the Joint Intelligence Objectives Agency, investigated and reported upon the process as developed and applied by the Adam Opel automobile factory, Russelheim, Germany, near Frankfurt.

The report discloses that sheets of aluminum were virtually melted together between gas heated dies closed under pressure. As the dies closed, compressed air was injected between the sheets to blow open areas between the welds. These areas created passageways conforming to the impressions in the die surface and the resultant sheets were then paired-up and welded to produce aircraft radiators.

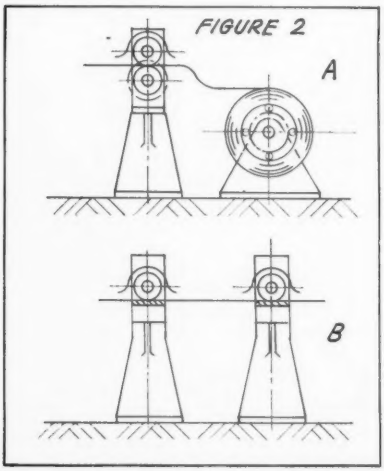


FIGURE 2

Figure 1 shows the assembly of the dies on the bed of the press. In this particular application, the gas fired dies were about 3 ft long, 2 ft deep and 2½ ft high over-all. The cross-section A-B, Figure 1, shows the sheets in position between the upper and lower members, the gas heating chambers and the outer water cooling passageways.

The aluminum strip stock used was in rolls about 300 ft long. The strip was a little over 9" wide and about .015" thick.

Throughout the process the stock had to be kept meticulously clean and free of any dampness that might cause oxidation. The stock was loaded on a power winch, A, Figure 2. From there the stock was run through two steel brush machines, B, Figure 2, in tandem, so that the inner side of the strip, and later the welded side, was thoroughly clean.

A preliminary press operation blanked and perforated the stock to a length double that of the radiator fin. The blanks were folded to one-half original length and an air inlet inserted in two of the meeting holes due to the fold. A pattern of a few spot welds maintained the blank in its folded shape and insured accurate positioning of the air inlet collar.

Figure 3 represents several stages of operation of the press welder. In position A, the press is open to receive the workpiece. The folded blank is placed between the upper and lower heated die members with the air inlet collar positioned over the air outlet nozzle

shown projected above the surface of the lower die. The gas heated dies work at a temperature of 450° C and the air introduced through the table of the press was preheated to the same temperature.

Positions B, C and D of Figure 3 represent the closing of the press. The pressure of the air cushion in the press table amounts to 2.5 to 3.5 atm. This is a variable that has to be adjusted to suit the physical properties of the material being worked. The stroke of the air cushion in this instance was 2.36" (60mm) and governed the welding time of the press welder. As the press closes, the air pressure builds up to 18 atm after 1.18" (30mm) closure and to a maximum of 24 atm when completion of the stroke has been effected, at which time the fin is fully inflated. The press operates at two strokes per minute.

After removal from the press, the fin was trimmed and then finished by burnishing the outside of the trimmed edge, and pressure tested.

In order to prevent the aluminum sheet from baking into the heated die surfaces, a thin film of a chemical preventive was applied lightly and evenly with a cloth to both sides of the stock. It was, as a consequence, found necessary to remove the accumulated residue from the working surfaces of the press after a run of from 10 to 15 fins. This had to be done most thoroughly with power driven steel brushes.

The setup inspected at this factory was arranged for accurate coordination between the first press operation of blanking and piercing, the spot welding jigs and the press welder proper. The entire production continuity was from the stock reel A, Figure 2, to the brushing machines, B, thence to the blanking and piercing press, spot welder, press welder, trimming press, compressed air tests, rim finishing, and final air inspection.

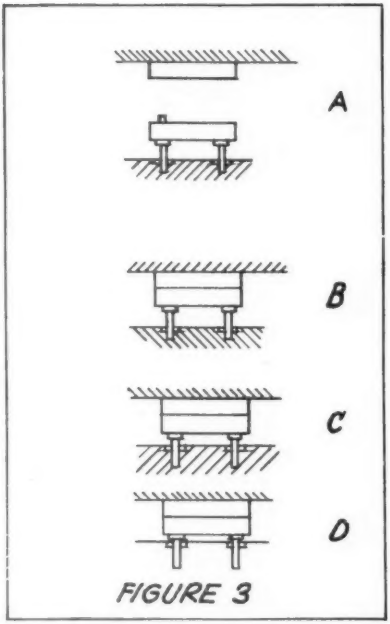
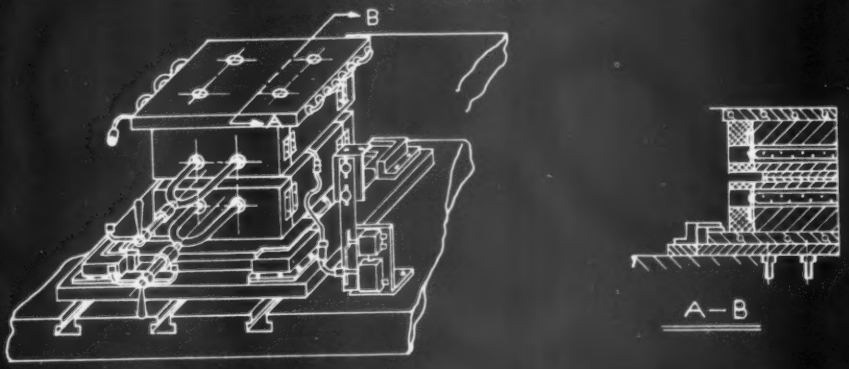


FIGURE 3

FIGURE 1



Beryllium Alloys • Physical Properties and Production Applications

Part II, Applications of Common Alloys

Applications of Beryllium Copper

The applications of beryllium copper may be divided into three classifications as follows:

by N. W. Bass
Sales Manager, Brush Beryllium Co.
Cleveland, Ohio

I. Where service demands require the specific properties of beryllium copper, hence no other material will do. For example, solenoid guides, which require a non-magnetic material with high abrasion resistance. Instrument diaphragms are often in this class as well as certain springs. Certain resistance welding electrodes and similar electrical parts operating under heavy pressures are also in this category.

II. Where shape, form and specifications of the finished article can in combination be achieved only through the use of beryllium copper. Certain progressive die operations are in this class. Many small spring parts for closely fitted assemblies are also included here, such as brush springs used in fractional horsepower electric motors. (See Fig. 4)

III. Where beryllium copper, although a more expensive material, can be fabricated more economically than cheaper materials. Many progressive die operations also apply here. (See Fig. 5) Hot hobbed molds for plastics are another

Figure 4. Beryllium copper springs, as shown, are commonly employed as brush holders in fractional horsepower electric motors.

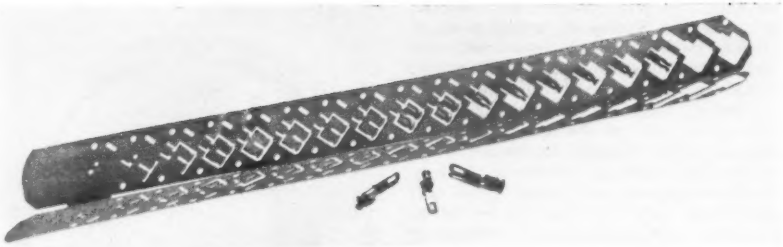


Figure 5. Beryllium copper lends itself well to being worked by progressive dies due to its economy of fabrication. Its non-magnetic property is a requirement for these electronic tube terminal clips, blanked and formed from beryllium copper strip stock.

example, since costly machining is eliminated.

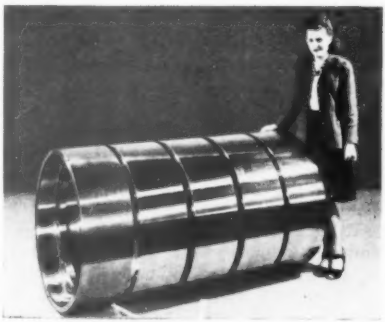
The above classifications are satisfied by the heat treated 2 percent beryllium copper which, as a finished material, has high strength, high endurance limit, good electrical conductivity, freedom from internal strains, and low drift or hysteresis. These qualities are coupled with high formability in the soft condition before heat treatment.

Two percent beryllium copper may also be cast, solution annealed and heat treated to yield high strength material. In the soft annealed conditions such castings may have a tensile strength of about 70,000 psi with an elongation of 35 percent in 2 inches and can reach as much as 180,000 psi after heat treatment, but with very little elongation in 2 inches. In this condition the Brinell hardness is 375-400.

The extremely refractory and tenacious nature of the dross, largely beryllium oxide, makes the casting of beryllium a matter of skill. For this reason centrifugal casting is frequently employed. Castings vary from articles less than an inch across to large parts for power transmission. Beryllium copper is also cast in sand and in other conventional ways. The "lost wax" or investment method of precision casting applied to beryllium copper is capable of yielding very high accuracy. With the physical properties developed, 2 percent beryllium copper may be considered as a low melting point stainless steel suitable for foundry work, but possessing also heat treatability with minimum deformation. For this reason, any finish machining can be performed in the soft annealed condition; final hardening by low temperature reheating. At the same time, the electrical conductivity of 2 percent beryllium copper is two or three times greater than stainless steel.

When annealed 2 percent beryllium copper is reheated to full hardness its linear dimensions decrease about 0.15 percent. This shrinkage results not only in a small direct change but also in actual deformation, particularly if a

Figure 6. Centrifugally cast beryllium copper brake drums for the diesel engines of the famous LST's contain .35 percent beryllium. These drums combine a high thermal conductivity with the necessary hardness and strength required for severe usage.



portion of the part has been cold worked, as in hobbing. Such cold worked portions harden earlier than those not cold worked, and therefore one section may change its dimensions while another is unaffected, with resulting deformation. This action has to be anticipated and estimated, but is small compared to the deformation induced by the high temperature quenching of most steels. It does mean, however, that hardening of annealed beryllium copper is frequently carried out in a jig, to prevent such deformation during the precipitation hardening treatment.

Second Copper Alloy

A second, less well known, type of beryllium copper alloy contains from 0.25 to 0.50 percent of beryllium with from 1.50 to 2.50 percent of nickel or cobalt, the balance substantially all copper. It is solutionized by heating at 900° C and quenching, with precipitation hardening taking place at 500° C. In the annealed condition its tensile strength is about 40,000 psi with about 30 percent elongation in 2 inches. When hardened the tensile strength increases to about 100,000 psi and elongation diminishes to from 1-8 percent in 2 inches. The corresponding Brinell hardness numbers are 55 and about 200 for the soft and hard conditions respectively.

The distinguishing characteristics of this 0.4 percent beryllium copper alloy are its high electrical and thermal conductivity and low cost in beryllium, which latter puts it in the cost range of phosphor bronze components. It also has stability at temperatures higher than the 2 percent beryllium copper alloy and promises to become much better known, even without a tin shortage. In thin sections it must be protected carefully from oxidizing conditions during its high temperature anneal and quench, but this is not important for castings. Fig. 6 illustrates 36-inch diameter centrifugally cast brake drums made of this alloy. These drums weigh about 625 pounds, and are used in marine reverse clutch and brake assemblies made by the Fawick Airflex Company, Cleveland, Ohio.

Considering next beryllium nickel, it should be noted that in a general theoretical way it is quite similar to 2 percent beryllium copper. The amount of beryllium used is from 1.9-2.75 percent and again we have solutionizing or annealing treatment with a subsequent precipitation hardening treatment. The respective temperatures required, however, are higher, being about 1050° C and 500° C. Brinell hardness numbers of between 500 and 600 may be obtained in the hardened condition, but may be as low as 140 in the annealed condition, which is associated again with very considerable ductility. Hardening by cold work is pronounced and mill products thus treated before hardening may reach, with subsequent heat treatment, the remarkable tensile strengths of 270,000 psi and still retain 8 percent elongation in 2 inches.

Figure 7. The hot hobbing of beryllium copper for mold cavities is rapidly becoming a more common practice. Note the high quality reproduction of mechanical detail and lettering.

Difficulties in fabrication have prevented this material from appearing on the market in the form of mill products, but there is steadily more interest appearing and for cold hobbed dies it may have much to offer.

Stainless Steel Alloy

In a third type of alloy, stainless steel

is the base and beryllium is added in amounts of 1-2 percent. This was suggested by the Germans in the year 1931.[4] It has been reported to possess the outstanding property of retaining its strength at red heat. Its hardness, however, is not greater than 350-400 Brinell. Very little has been known of this alloy in this country but some additional work has been done on this and similar alloys during the war years, and may later be publicized.

From what has been said it is apparent that all the precipitation or heat hardening alloys of beryllium with copper, nickel, or stainless steel may be used for plastics molds. Each of these alloys in the annealed or solutionized condition can be cold hobbed or machined, with minimum deformation after heat hardening.

Type of Alloy	Brinell Hardness Range	Operating Range °C	Thermal Conductivity (Percentage that of copper)	General Advantages
1. Beryllium Copper (0.4% Be)	200-225	200-300	55-65	Good thermal stability. Low relative cost. Extremely high conductivity.
2. Beryllium Copper (2-2¾% Be)	375-400	125-200	20-30	Hardness and castability. High thermal conductivity.
3. Beryllium Nickel (2-2¾% Be)	500-575	250-350	Low	Corrosion resistance. Extreme hardness.
4. Beryllium Stainless Steel (1% Be 12% Cr 11% Ni)	350-400	500-600	Low	High thermal stability. Corrosion resistance. Hardness.

Hot hobbing or hot pressing of beryllium copper is becoming more and more prevalent. Most beryllium copper mold cavities are now made in this manner. Other beryllium alloys may also lend themselves to this technique.

Pioneer work in the application of beryllium copper molds for plastics was carried on by the Gorham Manufacturing Co. in the year 1936 and continued in 1937. Their work was aimed at the production of finished beryllium copper molds from plaster models, and although tantalizingly promising, could never be carried to completion because the cost of eliminating small amounts of porosity made the molds uneconomical. It therefore seems that the hope of making finished plastics molds directly from plaster models through the use of beryllium copper is yet to be fulfilled.

Present day efforts at using these materials have taken another tack wherein the liquid beryllium alloy, usually beryllium copper, is poured over a cast iron or beryllium copper hob and pressed down upon it hydraulically while solidifying. This will be described in detail in an article by another contributor. It is pertinent to point out here that this is a more effective means for coping with porosity and minor defects. On the other hand, the more conventional methods of cold hobbing as applied to the annealed beryllium alloys have not been sufficiently investigated. These methods offer freedom from the possible large deformations introduced by case hardening and the high temperature quench involved in steel mold making. As shown in the table, the die maker has a wide choice of beryllium alloys from which to choose in making his die. For good results these materials must be supplied in a sound condition and free from porosity, either for hobbing or die cutting. Relative ease of working in the soft material should prove an inducement to wider applications.

(4) Wiss, Verdfent aus d. Siemens—Konzern Vol. X p. 33, 1931.

Speeds Machining Of Extruded Dural

Editorial Note: *In engineering studies preliminary to constructing this 20-gang cutter, engineers of the Friden Calculating Machine Company attended several meetings at which tools of this type were discussed. Almost everyone approached with the idea discouraged the plan, due to the possibility of chip congestion. Friden engineers, however, found a way around the chip problem by using a high pressure fluid and carefully staggering the position of the cutters. A chip catcher and strainer was also designed and built to separate the chips from the fluid.*

Designing of the fixture and cutter was completed by William Nonamaker and Lee Hathaway of the company's tool engineering department. Aiding in the actual construction were Fred Urquhart, tool department foreman and his aides, Nels Larson and Harold Robinson. Also in the picture were the Paragon Company, a subsidiary of Friden Company, and The Tool Specialty Company of Los Angeles, carbide cutter manufacturers.

by W. B. Nonamaker
Tool Superintendent
Tool Engineering Department
FRIDEN CALCULATING MACHINE CO.
San Leandro, California

In anticipation of Friden Calculating Machine Company's postwar production requirements, careful consideration was given, during the latter part of 1944, to the design of a multi-gang cutter and an air lock holding fixture for milling our calculating machine carriage frame members. These parts are fabricated from extruded 17ST Alcoa Dural metal.

Due to the lack of definite examples or case histories of large numbers of cutters in use in one gang, it was originally thought advisable to use all high speed steel cutters, but after careful study and consideration it was decided to design carbide tipped cutters for the purpose.

One reason for this decision was that in assembling a number of cutters of this type the relatively few teeth, namely eight on each cutter, lend themselves more readily to staggered positioning, thereby giving greater clearances through which chips can be flushed away at high cutting speeds than if more numerous-toothed high speed steel cutters are used.

The photos of the fixture and cutter are more or less self-explanatory although the following comments on some of the details are in order.

Figure 1 shows the parts of each frame with one each having had the first operation completed.

Figure 2 shows the positioning method of each part for the first milling operation. All finished sizes are controlled by

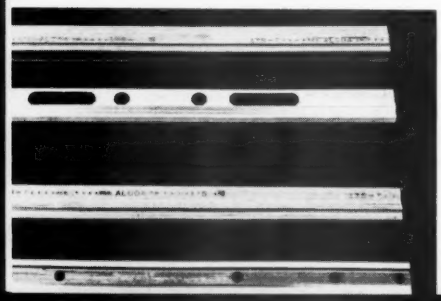


Figure 1. The parts for one frame showing each as having had the first operation completed. The material is 17ST extruded Dural.

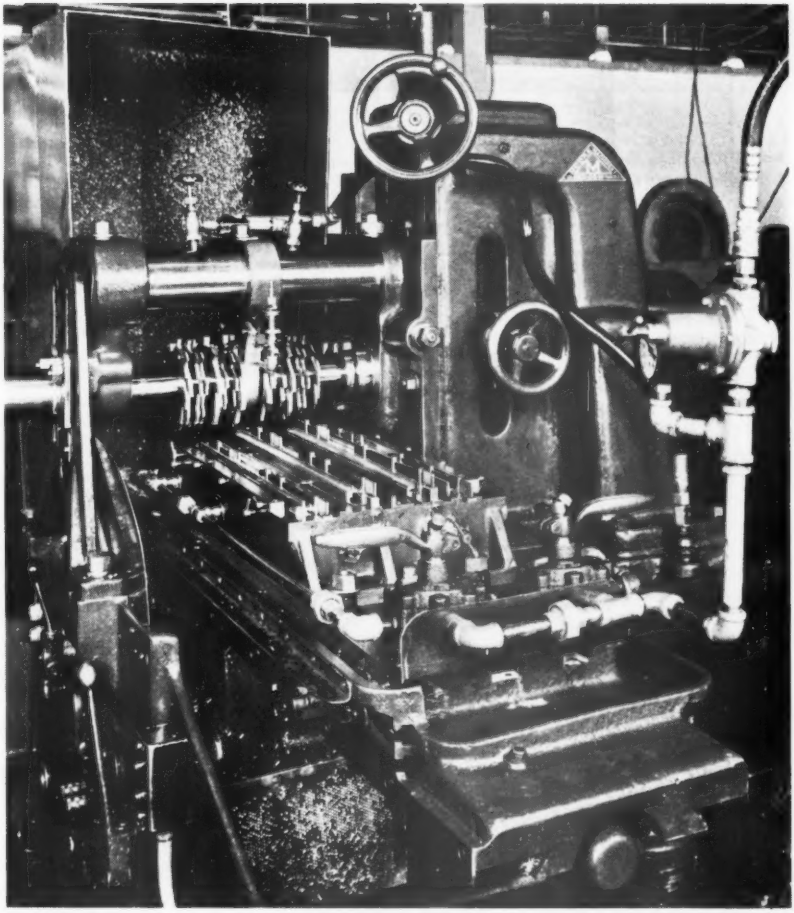


Figure 6. The setup of milling fixture, 20-gang cutter and frame sections in place for first cut. Chip catcher and strainer are shown with catcher swung back for photographing. Behind the airline and gage may be seen a portion of the flywheel, mounted on the rear of the spindle. This insures a smooth, vibration-free flow of power as the teeth engage the work.

locating from the inside surfaces of the frames. After the first operation, the part is reversed and clamped vise-like in position, and final machining of the part is completed.

It will be noted in Figures 3 and 5 that the hold-down studs are slotted to receive grip bars which in turn are clamped down upon the work by application of the air pressure.

The fixture contains four air cylinders, each of 2½" dia, as shown in the

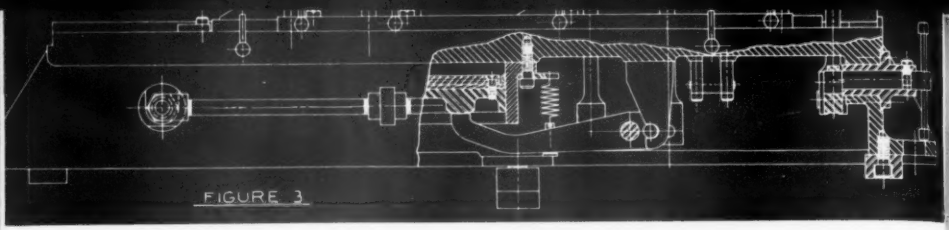
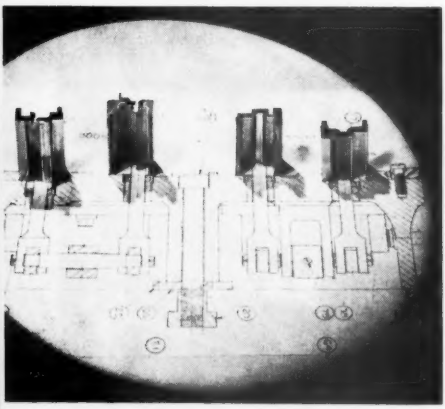
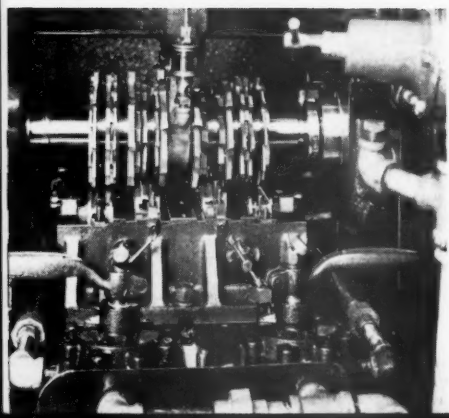


Figure 3. The fixture incorporates four air cylinders of 2½" dia of which one is shown here in cross-section. The lever linkage between the air cylinder and the hold-down studs gives a 10 to 1 mechanical advantage. With 40 lbs of air on the line, a clamping pressure of 400 lbs may be obtained.

Figure 2. Displaying the positioning method of each part for the first milling operation. All final dimensions are controlled by locating from the inside surfaces of the frame members. After the first operation the parts are reversed and clamped for the final machining. Figure 7. Close-up showing the gang cutters with the arbor rigidly supported by a bronze center bearing, cooled by an oil feed. The air clamping controls are seen in the foreground.





cross-section of Figure 3. The 10 to 1 mechanical linkage actuated by the air cylinders involves a pivoted cross-bar passing through two rocker links, thereby transmitting the working pressure to four hold-down studs. With each air cylinder and 40 lbs of air on the line, an exerted pressure of 400 lbs may be obtained.

The milling cutters are of approximately 6" dia, 8 teeth each and are tipped with No. 883 Carboloy. One cutter body for step milling is as narrow as one-tenth of an inch.

The axial positive rake is 10°, with a helical rake of 10° and a radial clearance rake of 7°. The arbor is rigidly supported by a center bronze bearing which in operation is cooled with an oil feed. A flywheel is mounted at the rear of the spindle giving a smooth flow of power by eliminating vibration.

Cutting is by the climb method only, and at a speed of 650 rpm or approximately 1000 surface feet per minute. The feed is 15 inches per minute, and material removal is .025 to .030 on all finished surfaces.

Although the cutting speed is not as fast as is the usual practice for this material, a definite comparison may be drawn by the fact that with previous fixtures in use, high speed steel cutters produced only 35 parts each on two fixtures per 8-hour day; whereas, the carbide cutters and the air fixture now produce 110 to 120 complete units of two parts each per 8-hour shift.

In addition, the carbide cutter will finish-machine 6000 frame units of two each per cutter sharpening. The high speed steel cutter previously in use finished only 1200 units each per sharpening, thereby increasing production 500% between cutter grinds.

The chip unit is a large cabinet-type

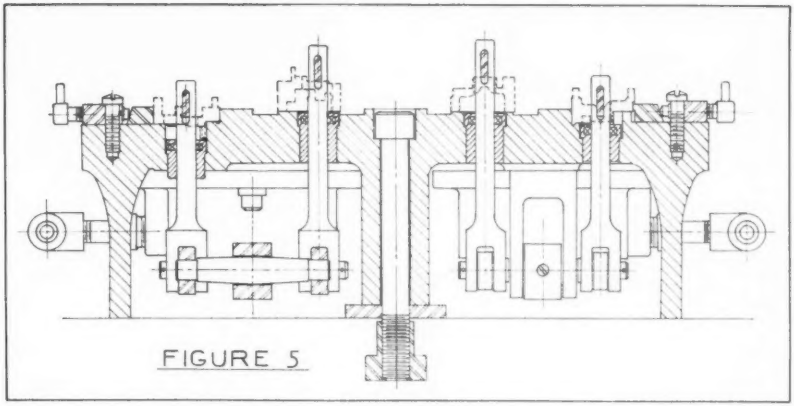
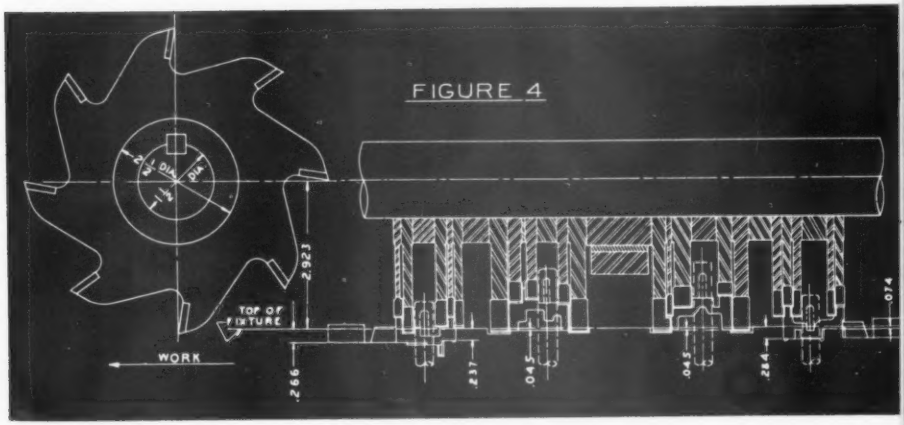


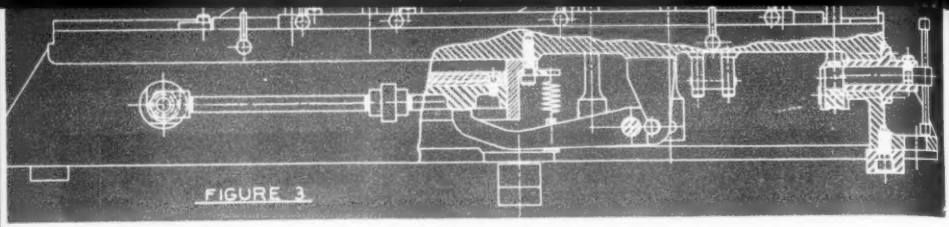
Figure 5. Cross-section of fixture showing pivoted cross-bar and rocker links which transmit and multiply pressure from air cylinders to hold-down studs.

metal box, arranged to catch all the chips thrown from the cutters while in operation. The fluid passes through a strainer and pump for re-use for cooling the cutters and scavenging the chips.

The results obtained by engineering and applying this unusual setup are gratifying to say the least, as the parts have a smooth finish and are held successfully to tolerances of from .0005 to .001 in dimension.

Figure 4. A half cross-section view of the 20-gang carbide-tipped cutter. The cutter diameters range from 4.732" to 6.062", and the face widths from .125" to .375". The 8-tooth design facilitates staggering the cutters on the arbor for best chip clearance.





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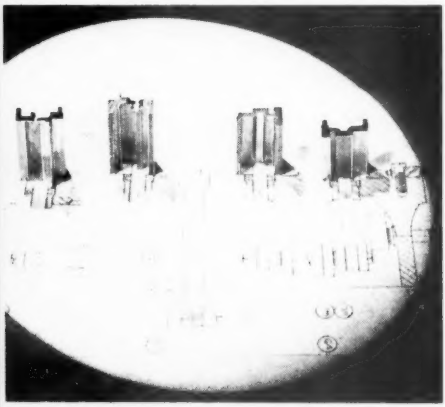

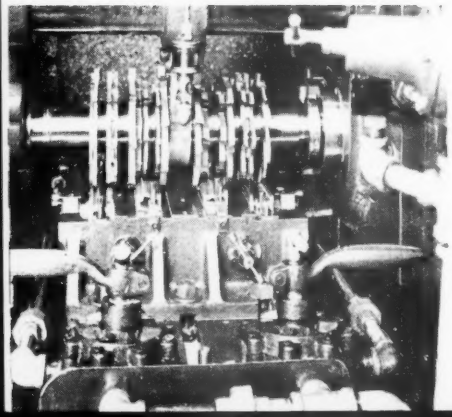

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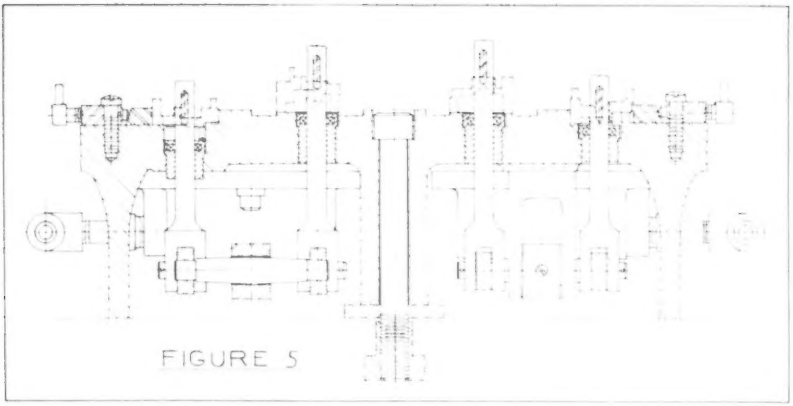

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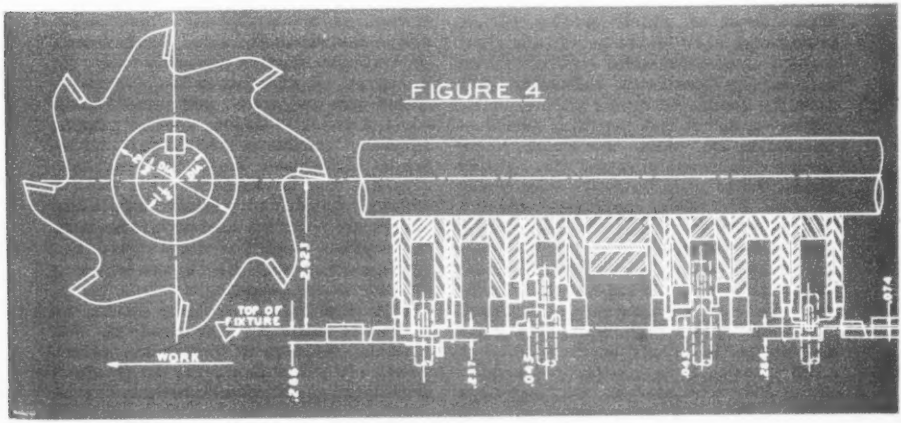
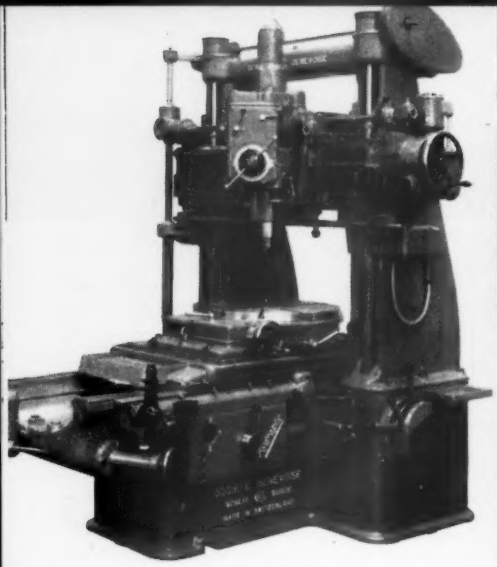
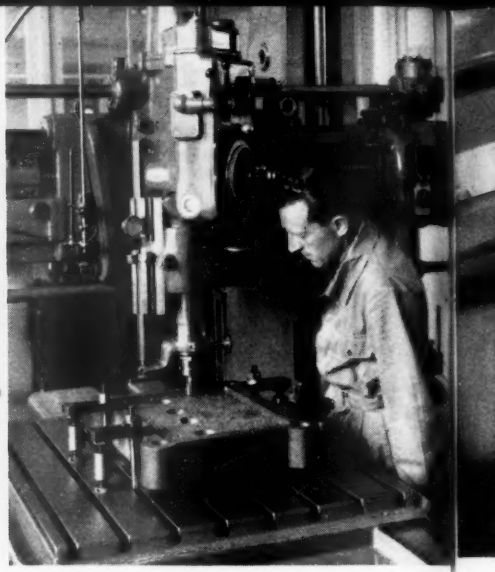






Optical Measuring System Assures Permanent Accuracy

Society Genevoise D'Instruments De Physique, Geneva, Switzerland, has developed a Jig Borer, known as the Hydroptic-B, on which reaming, facing, chamfering and milling can be performed, in addition to the regular drilling and boring operations ordinarily done on a jig borer.

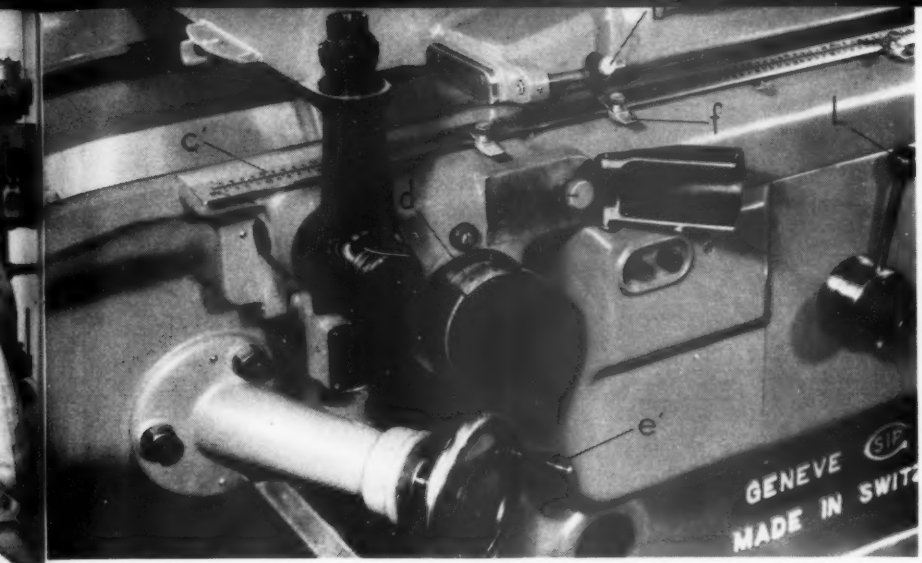
The table of this machine traverses longitudinally, while the spindle head moves transversely with the spindle saddle, both being equipped with power drives.

High precision standard scales, which are graduated on the same "SIP" Dividing Machines used in ruling standard scales for Official Bureaus of Weights and Measures, are used on this machine. One scale is mounted within the table and one in the spindle saddle.

Microscopes built into the bed and the cross slide are used in reading these scales. Thus the microscopes are fully encased with only the eye pieces exposed. The eye piece of the table microscope is supported on a tiltable bracket, so that it can lie below the table level when large work is being loaded. Both microscopes are easily accessible for the operator. A micrometer head of ample dimensions with a graduated drum divided in .001" and a vernier reading to .0001" is incorporated in each microscope. Millimeter scales and micrometers are also available.

This system of optical measuring represents a setting method in which the instruments are free from wear and mechanical stress, thereby contributing to permanent accuracy.

Jigs and fixtures, the precision of which is essential for securing full interchangeability of the parts manufactured, are machined on the Hydroptic-B with high speed, fine accuracy and at low cost.



Holes are located along rectangular co-ordinates by moving the work-table and the spindle saddle. A comprehensive range of spindle speeds and feeds meets any and all boring requirements. Milling work, incorporating the highest class finish, is due to the rigidity of the machine. This is evidenced by the fact that in the plants of several machine tool builders, the operation of milling guide ways is done by use of the Hydroptic-B machines to such a degree of precision that hand scraping has been eliminated.

Flexibility is a distinctive feature of the machine. It is capable of handling fine work as well as cumbersome jigs or components at economical rates of production. It is also suitable for laying out and machining cams, profile gages, templates, etc, and for locating abutments or dowel pins on elaborate fixtures.

In mould and die making, intricate profiles are duplicated without difficulty and limits held to a few ten-thousandths of an inch.

The Hydroptic-B can be employed to great advantage for the direct machining of small quantities of parts which do not justify the expense of special tooling. It also provides a means of rapidly machining certain components required to keep pace with the manufacturing program when the tooling production is delayed.

Among the numerous accessories available are the Circular Dividing Table and Tilting Rotary Table. Both are mountable on the regular work-table. The Circular Dividing Table is used for handling work dimensioned in polar co-ordinates. The same standard of precision is obtained with this table as on the regular table when the work is laid out in rectangular co-ordinates.

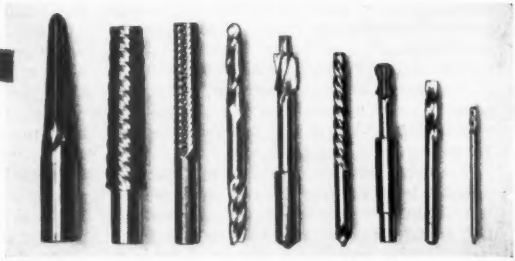
The Tilting Rotary Table is a compound swivel type of angular rotary table. The table top, when set in any plane, can be revolved through 360° by means of its rotary action. By its angular action, it can be turned from horizontal through 90° to a vertical position. This table is convenient when the complicated job of drilling or boring angular holes has to be done accurately, or holes have to be drilled at right angles in a workpiece. To accomplish this, the work is clamped to the table in the horizontal position, the necessary machine operations performed, and the table then turned upward to the specified angle the next operation calls for. Thus, working from the horizontal position to vertical, holes can be drilled at right angles.

Further detailed information on the Hydroptic-B will be sent on request from Cosa Corporation, Dept. TJ, 5000-4 Chrysler Bldg., New York 17, N. Y.

INFORM-A-GRAM KEY No. 250-N

Presenting

This versatile cutter and tool grinder not only sharpens cutters, it grinds them from the solid, quickly preparing special cutters when needed. ¶ The CINCINNATI Monoset is so flexible that all operations necessary in the grinding or making of many types of cutters can usually be accomplished with one chucking of the workpiece. Thus you are assured of excellent concentricity; all teeth are exactly alike and will carry an equal share of the cutting load. Here are some of the features that make the CINCINNATI Monoset extremely versatile and flexible: a) Infinitely variable spiral leads. b) Workhead swivel mount for generating accurate radii. c) Micrometer dials and stops for all slides. d) Simple, accurate indexing devices. e) Wheelhead adjustable in three planes. f) Workhead motor drive for cylindrical grinding. Further details about these features, together with engineering specifications, may be obtained by writing for catalog M-1386-1.



Examples of cutters which are easily ground on the CINCINNATI Monoset Cutter and Tool Grinder — many of them from the solid, and at one chucking.

CINCINNATI Mono-set Cutter and Tool Grinder. Catalog M-1386-1 contains complete specifications. Write for your copy today. A brief description of this machine is carried in Sweet's Catalog File.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI 9, OHIO, U. S. A.

MILLING MACHINES • BROACHING MACHINES • CUTTER SHARPENING MACHINES

Selection Of Cold Work Die Steels*

by Dr. G. M. Butler
Associate Director of Research
Allegheny Ludlum Steel Corporation

After all of the results of scientific research and metallurgical techniques have become embodied in the many tool steels now available, the user is still up against the problem of which die steel to select for a job which might involve stamping, coining, blanking, drawing or quite a variety of similar press and hammer operations. In most cases the labor cost in the die is far greater than the cost of the tool steel of which it is made. Hence it is desired that the diemaker use the steel best suited for the job, and in most cases the cost of that steel doesn't matter as much as other considerations which govern its selection.

Comparisons of Eight Die Steels

The presentation here is of a comparison of the various steels generally available for dies for cold work, with emphasis on the properties of each steel which may fit it to particular needs. The steels in this category are commonly purchased in the soft, annealed state for easy fabrication, then hardened by heat treatment to give them the strength and hardness necessary for use in forming other materials.

The steels under discussion are of eight types of die steel, Figure 1, arbitrarily divided into three groups, according to the quenching medium in which they are customarily hardened. This is a logical grouping because many of the properties of these steels go hand in hand with the manner of hardening.

Each of these steels is made by several U. S. makers of tool steels and many of you will, of course, think of these in terms of other steelmakers' brands which may be more familiar to you. You will find minor variations in analysis between the steels of any one type made by various companies, but the types are quite distinct and of characteristic properties.

The Water-Hardening Steels

The water-hardening steels, Figure 2, constitute the first group to be given detailed consideration. Straight carbon tool steel is the oldest of all tool steels and still of great importance. Almost any job can be done with some degree of success by a water-hardening steel, and some can be done only with such a steel. The itemized characteristics and shortcomings of this kind of steel should give a clear indication as to its field of usefulness.

Its uniquely valuable peculiarities may be considered first. It is a fact that no tool steel, no matter how highly alloyed, gets any harder after quenching than plain high carbon steel. The hardest test files are made out of carbon steel. Hard-

*From address delivered before the Pittsburgh and Rochester ASTE chapters.

ness is one very important requirement in a die.

It is also a fact, however, that carbon steels tend to harden only on the surface. Sections larger than about ¾ to 1" in diameter cannot be made hard throughout, no matter how drastic the quench. The surface may be file hard, but the core will be much softer. This can be a real advantage. Dies for cold or warm shearing in steel mills, for example, are often made of a carbon or carbon-vanadium steel. The working surface is hard and able to withstand the severe wearing actions of the metal being cut, while the core under the surface is tough enough to stand the battering shock of this process. If the die were to be hard all the way through, it would be very apt to split open after a few blows. The same is true of dies for wire and bar drawing. These are quenched through the hole to give a hard inside surface surrounded by a tough ring. Dies made of a deeper-hardening steel, which hardens all the way through, can be used only if a heavy backing ring is shrunk tight around them. Hammers, punches, and many another such sort of tool illustrate this same principle.

The other advantages of carbon steels, i.e., ease of machining and grinding, low hardening temperature, controlled depth of hardening, reasonable good wear resistance, versatility of application, wide range of carbon contents and qualities, and lastly, low cost, can all be summed up in the suggestion that you consider carbon tool steel first, then go to an alloy tool steel if you can't make carbon steel do your job.

That brings up the next question: when does carbon steel fail to satisfy? To answer that, it may be explained that the same properties that make some like it will turn others against it. For example, that matter of being shallow hardening: too often the poor heat-treater finds that this peculiarity has made soft spots appear on his dies where quenching could not act quickly enough; or the press operator sees the die impression crumbling and being pushed down into the core of the die due to an insufficient case thickness to sustain the load; or a die goes to the grinding room once too often for redressing and comes back without any hard surface.

Attempting to remedy this by ordering a carbon steel with deeper hardening properties may, more often than not, lead to an even worse trouble which appears as warpage or cracking after hardening. Shallow-hardening steels distort relatively little in hardening, but a deep-hardening steel of the same type will expand and distort much more. If changes of section or notches are present, this is just inviting cracking. So this danger of cracking and warping is drawback number two.

Drawback number three is the relatively poor wear resistance under severe conditions. Too often straight carbon steel just won't wear long enough.

The carbon-vanadium modification of straight carbon steel is more foolproof in hardening, in that it will stand overheating better and is essentially shallow-hardening, more so than many straight carbon steels. The vanadium content gives a fine grain which seems to add to the steel's shock resistance. Many users of carbon steels insist on a vanadium content, especially for such applications as cold heading dies. In such dies the heat-treater can increase depth of hardening by raising the hardening temperature, without having to worry about overheating.

From this it should be evident that water-hardening tool steels have many and varied uses but are scarcely suitable for dies with deep, intricate impressions,

Fig. 1. Modern Die Steels for Cold Work

	Allegheny Ludlum Grade
WATER HARDENING:	
Straight Carbon	Pompton
Carbon Vanadium	Python
OIL HARDENING:	
Manganese Oil Hardening	
1% Manganese Type	Saratoga
1½% Manganese Type	Deward
High-Carbon High-Chromium (2.2% Carbon)	Huron
AIR HARDENING:	
Manganese-Chromium-Molybdenum	Airloy
5% Chromium-1% Molybdenum	Sagamore
High-Carbon High-Chromium (1½% Carbon)	Ontario

Fig. 2. Characteristics of Water Hardening Steels

STRAIGHT CARBON (with about 0.8 to 1.1% carbon):
- High hardness.
- Low hardening temperature.
- Shallow hardening. Depth of hardening can be specified and controlled.
- Easily machined and ground.
- Low cost.
- Insufficient case depth for many jobs; danger of soft spots.
- Risk of cracking and warping.
- Insufficient wear resistance for long runs.

CARBON-VANADIUM (carbon steel with about 0.25% vanadium):

Compared with straight carbon steel, has:
- Finer grain and wider hardening range.
- Greater toughness.
- Shallower depth of hardening.
- Case depth can be increased by quenching from higher temperatures.

Fig. 3. Characteristics of Oil Hardening Steels

MANGANESE OIL HARDENING:
- 1% manganese type, with chromium and tungsten
- 1½% manganese type, with molybdenum
- Low hardening temperature.
- Little danger of cracking even in intricate sections.
- Low distortion.
- Easy to machine and grind.
- Moderately deep hardening.
- Good wear resistance and ability to hold cutting edge.
- Low toughness.

HIGH-CARBON HIGH-CHROMIUM (12% chromium, 2.2% carbon):
- High hardening temperature.
- Little danger of cracking.
- Low distortion.
- Difficult to machine and grind.
- Deep hardening.
- Superlative wear resistance and compressive strength.
- Low toughness.
- High cost.

or dies which must be hard all the way through to stand the service stress, or dies which must wear for a long time, hence their place in the die field is definitely limited.

The Oil-Hardening Steels

Consequently, we turn to the steel maker for alloy tool steels which can be hardened by less drastic quenching than water or brine. The most important advantage gained by this more gentle quench is less danger of cracking and reduced warpage and distortion. In fact, all of the steels in the oil and air hardening classes are commonly called "non-deforming"; a term to be taken with a few grains of salt, but the effect is certainly one of greater safety in hardening. Furthermore, the alloying elements also add to the wear resistance, toughness, and depth of hardening, so that they can really pay for their added cost.

In considering the oil-hardening group, Figure 3, I have selected only two types in this class, out of quite a lot of related kinds because in the great majority of die applications one of these two types will do the job very well. Know these steels well and you will be able to lick most die jobs.

The manganese oil-hardening steels are used the world around. There are actually two of these steels, differing mainly in manganese content. Both are popular. There are probably more makers offering the 1% manganese kind, which we call Saratoga, but we feel that the higher-manganese steel with a little molybdenum, our Deward, is a better steel. At any rate, it distorts somewhat less. Figure 3 shows the distinctive characteristics of this class: it is easy to machine and grind; is quite safely hardened from a low temperature in oil, with little danger of cracking and low distortion; is moderately deep hardening, has good wear resistance, and has ability to hold a keen cutting edge. All told, a very widely used and very valuable steel for gages, drawing and forming dies, plastics molding dies, master form tools, stamping and blanking dies, taps, and so forth, through almost the entire field of die engineering.

However, when the tool designer wants the very longest-lived die steel under severe usage, he buys the 2% carbon-12% chromium oil-hardening steel. This steel is a mass of hard chromium carbides, which makes it superlatively resistant to abrasion. At the same time, this steel has great resistance to compressive force, is very deep hardening, and deforms relatively little in heat treatment. Such applications as long-run blanking dies, dies for deep-drawing, slitting cutters, forming rolls, and many

Fig. 4. Characteristics of Air Hardening Steels

MANGANESE-CHROMIUM-MOLYBDENUM (2-3% manganese, 1-2% chromium, 1% moly):
- Low hardening temperature.
- Negligible cracking hazard.
- Least distortion of all tool steels.
- Rather difficult to machine; quite easy to grind.
- Deep hardening.
- Moderately tough.
- Somewhat better wear resistance than manganese oil hardening.
- Limited availability.

5% CHROMIUM—1% MOLYBDENUM:
- Intermediate hardening temperature.
- Negligible cracking hazard.
- Low distortion, but more than manganese-chromium-molybdenum.
- Deep hardening.
- Toughest of all alloy die steels.
- Wear resistance about like manganese-chromium-molybdenum.

HIGH-CARBON HIGH-CHROMIUM (12% chromium with 1½% carbon plus molybdenum):
- High hardening temperature.
- Negligible cracking hazard.
- Almost as low distortion as manganese-chromium-molybdenum.
- Deep hardening.
- Low toughness.
- High cost.

other uses have proved the longevity of this steel.

Such virtues are accompanied, of course, by some decided shortcomings, which often discourage prospective users of this steel. They soon discover that its machinability is poor compared with carbon steel, and their experiences with grinding it in the hardened state are apt to be painful until they forget what they knew about grinding low-alloy steels. Heat treating temperatures are fairly high and the use of atmosphere furnaces or pack-hardening is very desirable. This steel has relatively low resistance to shock or bending, so that proper support of the die becomes very important. Lastly the steel is quite expensive.

Therefore, the engineer who specifies the oil-hardening high-carbon high-chromium type of steel for his work must pay a good deal of attention to the skill of the die maker and proper design of the die so as to avoid bending stresses and permit most economical fabrication. In the hands of experienced men, this steel is safely and readily made into dies, and its performance justifies its cost. An outstanding application of our Huron die steel is for lamination dies. Millions of stampings for motors and transformers are being produced on a single die. These intricate sectional dies, hardened to 62 Rockwell C and composed of many segments fitted to less than a tenth of a thousandth of an inch, start life about an inch and a quarter thick, and are resharpened periodically by the removal of a new thousandths of an inch by surface grinding. Often they can be used until they are too thin to fasten to the backing block. Our long experience with this steel enables our company to help many users who might otherwise have trouble with it.

The Air-Hardening Steels

The third and last general group is the air-hardening class of die steels. These steels are comparative newcomers. They grew out of demands for steels which deformed in hardening still less than the oil-hardening types, hence the metallurgists evolved these three air-hardening steels, Figure 4, of almost negligible dimensional change in hardening. Once their nature is understood, the die-maker can leave little or no allowance for grinding after hardening. All will harden throughout in sections commonly used in die design. These steels have not yet won the wide use that oil hardening steels enjoy, but I think it

Fig. 5. Order of Distortion Tendencies of Die Steels

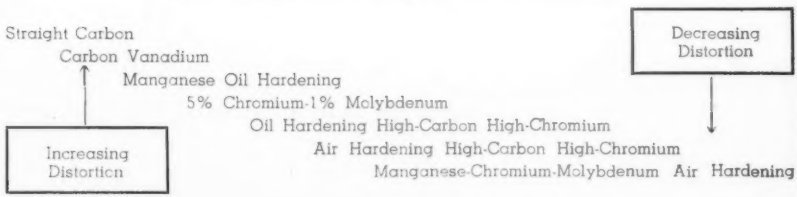
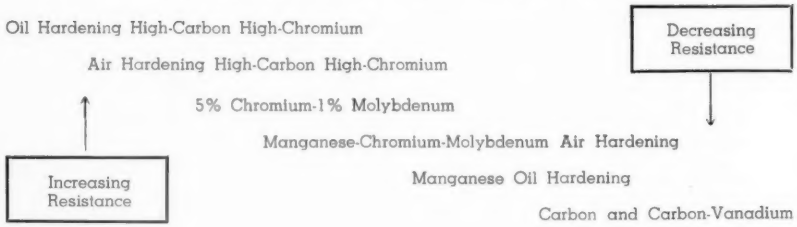


Fig. 6. Comparative Wear Resistance of Die Steels



is safe to predict that they will become increasingly popular.

The first one, the manganese-chromium-molybdenum type, hardens from the lowest temperature range and is inherently the least deforming of all die steels. Its alloy content is high enough for a good degree of wear resistance. It is rather hard to machine, since it will not anneal very soft; and this same annealing difficulty makes it hard to rework after hardening. This steel is not very generally available.

One unique application of this steel is for toolmakers' flats. These are usually made out of a water hardening steel which can be hardened in oil in thin sections. Even oil quenching, however, causes considerable distortion in water hardening steels, so that the heat-treated piece must be straightened or ground. But templates, gages, and similar parts made of the air hardening variety can be hardened merely by cooling in air from the same temperature as used for carbon steels, and will show negligible warping or dimensional change.

The second air hardening steel, the 5% chromium-1% molybdenum steel, has been winning more general acceptance than the manganese type. Apparently most die steel users don't mind a somewhat higher hardening temperature and don't need the very minimum of dimensional change in hardening, because this 5% chromium steel is becoming very popular. This steel shows a fine combination of easy, safe hardening, good wear resistance, and unusual toughness. It is now being applied on quite a number of blanking, forming, and trimming dies which are usually made of the high-carbon high-chromium types. Its lower cost and somewhat easier machining and grinding are factors that have influenced this change.

The third air hardening steel, a high-carbon high-chromium type with somewhat lower carbon than its oil hardening counterpart, has been given a shot of molybdenum to encourage it to harden in air. It is the star performer of the air hardening steels, just as the 2% carbon variety outshines the other oil and water hardening steels. It owes its widespread use to the same reasons that have made the other air hardening steels popular: safety in heat treatment. The maker of an intricate blanking die, such as a lamination die, may choose to make it all in one piece, or he may make it in sections. If it is to be one piece, he would do well to use this air harden-

Fig. 7. Relative Toughness of Die Steels

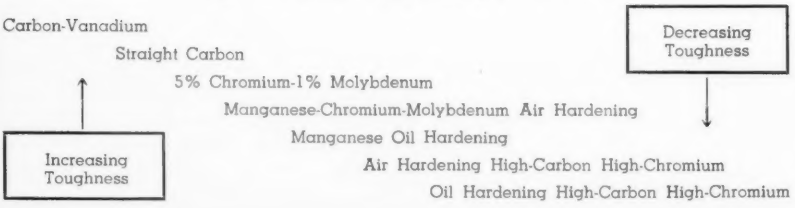
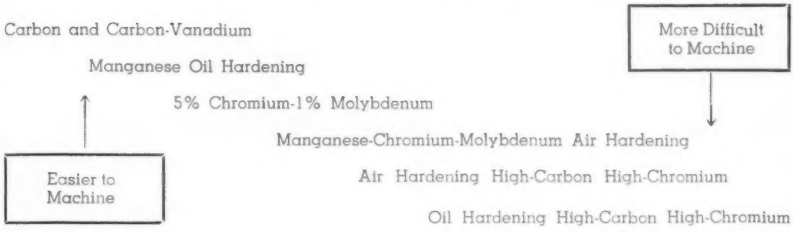


Fig. 8. Relative Ease of Machining of Die Steels



ing type. The number of pieces which his one-piece die will produce between sharpenings will be slightly less than from a die made of the oil hardening type containing more chrome carbides but the manufacturing cost of the die will be less and it can be hardened with less warpage and very little fear of cracking. Thus he gains in safety and first cost, at the expense of only slightly less production.

Dies made of either of these high-carbon high-chromium steels are generally machined in the soft state, then hardened and finished to size by grinding. Filing is avoided. The lack of toughness of these steels often leads users to back them up by heavy steel or cast iron blocks.

The use of air hardening steels has been made more attractive by recent progress in bright hardening. Furnaces are now available which permit heating and cooling dies in an atmosphere which is so inert that the pieces come out as bright as they went in.

Die Steel Behavior Ratings

Figures 5, 6, 7 and 8 are set up to show a few of the most important die steel characteristics arranged in such a way as to indicate the relative behavior of each steel. You may wish to argue with my ratings, but please bear in mind that the apparent merit of a steel is influenced to such a great degree by the way in which it is used that about all anyone can do is to try to strike an average which will be reasonably usable.

Which Steel?

When the die designer, with all the foregoing more or less clearly fixed in his mind, is confronted with a new job and sets out to specify a tool steel which has a reasonable chance of doing the work, his thoughts should run somewhat along the following lines:

If the die seems quite simple with no great variations in section, he'll think seriously of a water hardening steel. Then he'll look into the possible risk of cracking or warping in hardening; if his heat treater says he wouldn't take a chance on such a die if made of a water hardening steel, he'll go to a manganese oil hardening type, especially if the design is intricate. Or if long runs are wanted, one of the high-carbon high-chromium steels is a logical choice.

If there isn't any chance for grinding after hardening to correct for dimensional change, he'll certainly select an air-hardening steel. This will be the manganese-chromium-molybdenum or the 5% chromium type unless he wants very long runs. In the latter case it will be the air hardening high-carbon high-chromium die steel.

Naturally he starts with the least expensive, most easily worked die steel and goes to the higher-alloy types only when difficulties of heat-treating or service demands make such a change mandatory. This oversimplifies his problem, of course; but actually the choice of the best cold work steel isn't too much more involved than that. When he understands the significance to his work of the factors I have tried to outline, he can pick out a die steel with reasonable assurance that it will do the job satisfactorily.

For your copy of Allegheny Ludlum's Tool Steel Handbook, containing engineering data on tool and die steel properties, uses and selection, check Inform-A-Gram Key No. 678-N.

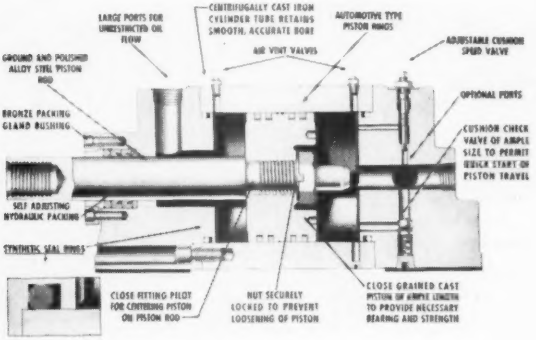
Centrifugal Casting Improves Cylinder Structure And Performance

Maximum power without leakage and lasting accuracy of bore dimensions are two outstanding features of the improved Logan "Rotocast" hydraulic cylinders. These cylinders are adapted for a wide range of operations involving: pushing, clamping, lifting, forcing, holding, pulling, pressing and other power movements in any direction. They can be used advantageously on new or old equipment in manufacturing and processing industries, materials handling and many other applications in diversified fields.

The cylinder barrels are centrifugally cast from close-grained gray iron which retains its original dimensional accuracy for the life of the cylinder. This permits smooth, true bores, honed to a mirror finish, and assures a uniform flow of power with minimum friction and piston leakage. Four automotive type piston rings further contribute to positive operation with maximum power.

Conventional gaskets have been eliminated in the new "Rotocast" cylinder. In their place, soft synthetic "O" rings are used to provide a permanently leakproof seal between the cylinder barrel and end covers. These "O" rings maintain a perfect seal even though the applied pressure is increased or decreased, and have a far longer service life than the usual gaskets. Small tapped holes are provided at various locations in each end of the cylinder barrel. This construction permits the locating of air vent valves in a position which will allow air to be vented or bled from the highest point, regardless of the mounted position of the cylinder.

Cover attachment holes are standard on all models, making the covers of the various types completely interchangeable so that a wide range of combination mountings, such as flange mounting at rod end with foot mounting at blind end, etc., is possible. Standard mounting types include rabbeted, foot, center-line, clevis, trunnion, flange at blind end, and flange at rod end. In order to fit the greatest number of applications, they are offered in 7 mounting types, 3 piston rod models and 9 standard bores, and are available with cushioning at one or both ends, if desired. Cylinders are built for operating pressures to 1500 psi.


LARGE PORTS FOR UNRESTRICTED OIL FLOW
CENTRIFUGALLY CAST IRON CYLINDER TUBE RETAINS SMOOTH, ACCURATE BORE
AUTOMOTIVE TYPE PISTON RINGS
ADJUSTABLE CUSHION SPEED VALVE
AIR VENT VALVES
GROUND AND POLISHED ALLOY STEEL PISTON ROD
OPTIONAL PORTS
BRONZE PACKING GLAND BUSHING
CUSHION CHECK VALVE OF AMPLE SIZE TO PERMIT REDUCE START OF PISTON TRAVEL
SELF ADJUSTING HYDRAULIC PACKING
SYNTHETIC SEAL RINGS
CLOSE FITTING PILOT FOR CENTERING PISTON ON PISTON ROD
NUT SECURELY LOCKED TO PREVENT LOOSENING OF PISTON
CLOSE GRAINED CAST PISTON OF AMPLE LENGTH TO PROVIDE NECESSARY BEARING AND STRENGTH

Those interested in securing additional information on these improved hydraulic cylinders may address their inquiries to the Logansport Machine Co., Inc., Dept. DJ, Logansport, Indiana, manufacturers of air and hydraulic equipment.

INFORM-A-GRAM KEY No. 372 N

TDJ SHOP DATA SHEET NO. 39

Rectangular Co-ordinate Dimensions vs Polar Co-ordinates

This data sheet is a continuation of the demonstration given on Data Sheet No. 37, which shows the conversion from rectangular co-ordinate dimensions to polar co-ordinate dimensions and vice versa, where the center of one of the holes was used as the layout center.

This demonstration goes through a similar conversion, but uses the center of the workpiece as the layout center.

Figure 1 shows a layout with "step" dimensions. Figure 4 is the same layout with the rectangular dimensions converted to polar co-ordinate dimensions superimposed. The center of the workpiece is taken at the intersection of X-X and Y-Y. The symbol VH_1 represents the vertical distance from line X-X to the center of hole H_1 and the HH_1 symbol the horizontal distance from Y-Y to the center of hole H_1. Therefore, the VH and HH values are:

$VH_1 = 3.6875 - 2.625 = 1.0625$

$HH_1 = 3.125 - 1.125 = 2.000$

$VH_2 = 2.625$

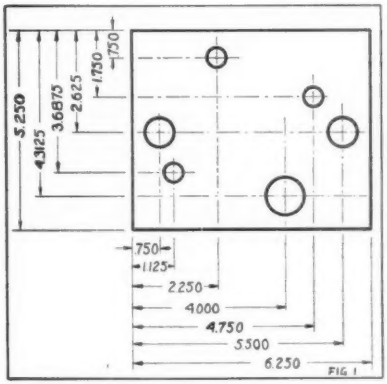


FIG. 1

$HH_2 = 3.125 - .750 = 2.375$

$VH_3 = 2.625 - .750 = 1.875$

$HH_3 = 3.125 - 2.250 = .875$

$VH_4 = 2.625 - 1.750 = .875$

$HH_4 = 4.750 - 3.125 = 1.625$

$VH_5 = 2.625$

$HH_5 = 5.500 - 3.125 = 2.375$

$VH_6 = 4.3125 - 2.625 = 1.6875$

$HH_6 = 4.000 - 3.125 = .875$

Let Y-Y serve as the reference line from which all angles are computed. Then a_1 is formed by Y-Y and R_1 with VH_1 and HH_1 completing a right angle triangle.

$$\text{Tan } a_1 = \frac{HH_1}{VH_1} = \frac{2.000}{1.0625} = 1.8823$$

Then $a_1 = 62° 1' 17''$ (see Table)

$$R_1 = \frac{HH_1}{\sin a_1} = \frac{2.000}{\sin 62° 1' 17''} = \frac{2.000}{.88312} = 2.2647 \text{ (see Table)}$$

Since H_2 lies on center line XX, it is 90° from YY, therefore,

$a_2 = 90°$

$R_2 = HH_2 = 3.125 - .750 = 2.375$

$a_3 = 180° - S_3$, where S_3 = the angle formed by VH_3 and R_3

$$\text{Tan } S_3 = \frac{HH_3}{VH_3} = \frac{.875}{1.875} = .46666 \text{ (see Table)}$$

Then $a_3 = 180° - 25° 1' 0'' = 154° 59' 0''$

$$R_3 = \frac{HH_3}{\sin S_3} = \frac{.875}{\sin 25° 1' 0''} = \frac{.875}{.42288} = 2.0691 \text{ (see Table)}$$

$a_4 = 180° + S_4$

$$\text{Tan } S_4 = \frac{HH_4}{VH_4} = \frac{1.625}{.875} = 1.85711 \text{ (see Table)}$$

Then $a_4 = 180° + 61° 41' 57'' = 241° 41' 57''$

$$R_4 = \frac{HH_4}{\sin S_4} = \frac{1.625}{\sin 61° 41' 57''} = \frac{1.625}{.880473} = 1.8456 \text{ (see Table)}$$

Since H_5 lies on center line X-X, it is 270° from the starting point on Y-Y, therefore,

$a_5 = 270°$

$R_5 = HH_5 = 5.500 - 3.125 = 2.375$

$a_6 = 360° - S_6$

$$\text{tan } S_6 = \frac{HH_6}{VH_6} = \frac{.875}{1.6875} = .51852 \text{ (see Table)}$$

Then $a_6 = 360° - 27° 24' 27'' = 332° 35' 33''$

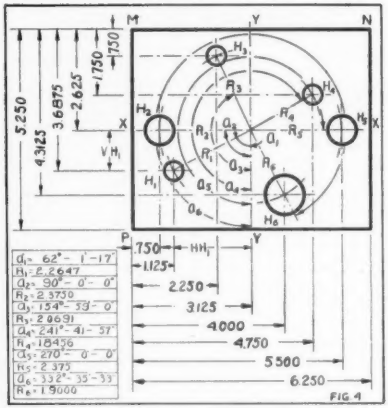


FIG. 4

$$R_6 = \frac{HH_6}{\sin S_6} = \frac{.875}{\sin 27° 24' 27''} = \frac{.875}{.46032}$$
$$= 1.9000 \text{ (see Table)}$$

Figure 5 represents the layout of Figure 1 converted to polar co-ordinates. Let it be assumed that Figure 5 is now the original and that the polar co-ordinates are to be converted to rectangular or "step" dimensions. The procedure is the same as in the demonstration using Figure 3, Data Sheet No. 37, but the polar co-ordinate dimensions are different. The same symbols will be used as in the preceding example, working through Figure 4, which can now be considered the layout from Figure 5 with Figure 1 superimposed on it.

The angles and radii to the several holes are known and the problem is to find VH and HH for each of these holes.

$$\text{Sin } a_1 = \frac{HH_1}{R_1}$$

$$HH_1 = R_1 \text{ Sin } a_1$$
$$= 2.2647 \text{ sin } 62° 1' 17''$$
$$= 2.2647 \times .88312 = 2.000 \text{ (see Table)}$$

$$PH_1 = PY - HH_1 = 3.125 - 2.000 = 1.125$$

$$\text{Cos } a_1 = \frac{VH_1}{R_1}$$

$$VH_1 = R_1 \text{ Cos } a_1$$
$$= 2.2647 \text{ Cos } 62° 1' 17''$$
$$= 2.2647 \times .46914 = 1.0625 \text{ (see Table)}$$

$$MH_1 = MX + VH_1 = 2.625 + 1.0625$$
$$= 3.6875$$

Since H_2 is on center line XX, then
$R_2 = HH_2 = 2.375$
$PH_2 = PY - HH_2 = 3.125 - 2.375 = .750$
$MH_2 = VH_2 = MX = 2.625$

$$HH_3 = R_3 \text{ Sin } (180° - a_3)$$
$$= 2.0691 \text{ Sin } (180° - 154° 59')$$
$$= 2.0691 \text{ Sin } 25° 1'$$
$$= 2.0691 \times .42288 = .875 \text{ (see Table)}$$
$$PH_3 = PY - HH_3 = 3.125 - .875 = 2.250$$

$$VH_3 = R_3 \text{ Cos } (180° - a_3)$$
$$= 2.0691 \text{ Cos } (180° - 154° 59')$$
$$= 2.0691 \text{ Cos } 25° 1'$$
$$= 2.0691 \times .90618 = 1.875 \text{ (see Table)}$$
$$MH_3 = MX - VH_3 = 2.625 - 1.875 = .750$$

$$HH_4 = R_4 \text{ Sin } (a_4 - 180°)$$
$$= 1.8456 \text{ Sin } (241° 41' 57'' - 180°)$$
$$= 1.8456 \text{ Sin } 61° 41' 57''$$
$$= 1.8456 \times .880473 = 1.625 \text{ (see Table)}$$
$$PH_4 = PY + HH_4 = 3.125 + 1.625 = 4.750$$

$$VH_4 = R_4 \text{ Cos } (a_4 - 180°)$$
$$= 1.8456 \text{ Cos } 241° 41' 57'' - 180°$$
$$= 1.8456 \text{ Cos } 61° 41' 57''$$
$$= 1.8456 \times .47410 = .875 \text{ (see Table)}$$
$$MH_4 = MX - VH_4 = 2.625 - .875 = 1.750$$

Since H_5 is on center line XX, then
$R_5 = HH_5 = 2.375$
$PH_5 = PY + HH_5 = 3.125 + 2.375 = 5.500$
$MH_5 = VH_5 = MX = 2.625$

$$HH_6 = R_6 \text{ Sin } (360° - a_6)$$
$$= 1.900 \text{ Sin } (360° - 332° 35' 33'')$$
$$= 1.900 \text{ Sin } 27° 24' 27''$$
$$= 1.900 \times .46032 = .875 \text{ (see Table)}$$
$$PH_6 = PY + HH_6 = 3.125 + .875 = 4.000$$

$$VH_6 = R_6 \text{ Cos } (360° - a_6)$$
$$= 1.900 \text{ Cos } (360° - 332° 35' 33'')$$
$$= 1.900 \text{ Cos } 27° 24' 27''$$
$$= 1.900 \times .88775 = 1.6875 \text{ (see Table)}$$
$$MH_6 = MX + VH_6 = 2.625 + 1.6875 = 4.3125$$

These rectangular dimensions correspond to those in Figure 1.

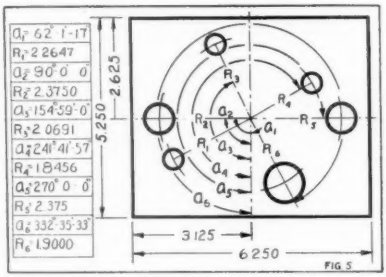


FIG. 5

TRIGONOMETRIC VALUES

Angles	Sin	Cos	Tan
25° 1' 0"	.42288	.90618	.46666
27° 24' 27"	.46032	.88775	.51852
61° 41' 57"	.880473	.47410	1.85711
62° 1' 17"	.88312	.46914	1.8823

TDJ SHOP DATA SHEET NO. 40

Approximate Blank Diameters for Drawn Shells (inches)

SHELL DIAM. (inches)	DEPTH OF DRAW (inches)					
	5.000	5.250	5.500	5.750	6.000	6.500
3.125	8.50	8.68	8.86	9.03	9.20	9.54
3.250	8.69	8.88	9.06	9.23	9.41	9.75
3.375	8.88	9.07	9.25	9.43	9.61	9.96
3.500	9.06	9.26	9.45	9.63	9.81	10.16
3.625	9.25	9.45	9.64	9.82	10.00	10.36
3.750	9.44	9.63	9.82	10.01	10.20	10.56
3.875	9.61	9.82	10.01	10.20	10.39	10.76
4.000	9.79	10.00	10.20	10.39	10.58	10.95
4.125	9.97	10.18	10.38	10.57	10.76	11.14
4.250	10.15	10.35	10.56	10.76	10.95	11.33
4.375	10.32	10.53	10.74	10.94	11.14	11.52
4.500	10.50	10.71	10.92	11.12	11.32	11.71
4.625	10.67	10.88	11.09	11.30	11.50	11.90
4.750	10.84	11.05	11.27	11.47	11.68	12.08
4.875	11.01	11.23	11.44	11.65	11.86	12.26
5.000	11.18	11.40	11.61	11.83	12.04	12.45
5.125	11.34	11.57	11.79	12.00	12.21	12.63
5.250	11.51	11.74	11.96	12.17	12.39	12.81
5.375	11.68	11.90	12.13	12.35	12.56	12.98
5.500	11.84	12.07	12.29	12.52	12.73	13.16
5.625	12.00	12.23	12.46	12.69	12.90	13.33
5.750	12.16	12.40	12.63	12.85	13.07	13.51
5.875	12.32	12.56	12.79	13.02	13.24	13.68
6.000	12.48	12.72	12.95	13.19	13.41	13.85

TDJ SHOP DATA SHEET NO. 41

Approximate Blank Diameters for Drawn Shells (inches)

SHELL DIAM. (inches)	DEPTH OF DRAW (inches)					
	7.00	7.50	8.00	8.50	9.00	9 50
3.125	9.86	10.17	10.48	10.77	11.06	11.34
3.250	10.08	10 40	10 70	11 00	11.29	11.58
3.375	10.29	10.61	10.93	11.23	11.53	11.82
3.500	10.50	10.83	11 15	11.46	11.76	12.05
3.625	10.71	11 04	11 36	11.68	11.98	12.28
3.750	10.91	11.25	11.58	11 90	12.21	12 51
3.875	11.11	11.45	11.79	12 11	12.43	12.74
4.000	11.31	11.66	12.00	12.33	12 65	12 96
4.125	11.51	11.86	12.20	12.54	12.86	13.18
4.250	11.71	12.06	12.41	12 75	13 07	13.40
4.375	11.90	12.26	12.61	12.95	13.29	13 61
4.500	12.09	12.45	12.81	13 16	13.50	13 82
4.625	12.28	12.65	13.01	13.36	13.70	14 04
4.750	12.47	12.84	13.21	13.56	13.91	14 25
4.875	12.65	13.03	13.41	13.76	14.11	14 45
5.000	12.84	13.23	13.60	13.96	14 32	14 66
5.125	13.03	13.41	13.79	14.16	14.52	14.86
5.250	13.21	13.60	13.98	14.35	14.71	15 07
5.375	13.39	13.79	14.17	14.54	14.91	15.27
5.500	13.57	13.97	14.36	14.73	15.11	15.47
5.625	13.75	14.15	14.54	14.93	15.30	15.66
5.750	13.93	14.33	14.73	15.11	15.49	15.86
5.875	14.10	14.51	14.91	15.30	15.68	16.05
6.000	14.28	14.69	15.10	15.49	15.87	16.24

INDUSTRIAL DIGEST

Science • Research • Methods • Tooling • Production • Trade News and Reports

Western Europe Export Prospects

Western European countries have demonstrated "remarkable recuperation from wartime stress, and will, economic conditions permitting, provide export outlets for many types of American products, particularly in the machine tool and equipment fields." William L. Dolle, president and general manager of The Lodge & Shipley Machine Tool Co., made this observation recently on his return from a European trip. He said he was, "agreeably surprised at the strides in evidences for speedy re-establishment of peace-time economy as rapidly as posisble in Western Europe."

Visiting England, Belgium, the Netherlands, France and Switzerland, coupled with conferences with business men in these countries, provided an opportunity to observe and survey business and economic conditions and trends, together with a view of evident immediate needs available to be filled by American producers.

As to France, Belgium and the Netherlands, he believes that these countries are "good prospects for American Exports, provided monetary exchange facilities and conditions enable these countries to make imports on a basis comparable to those from other producing nations, with the further proviso that a mutually agreeable system of exchange can be arranged."

ASA Catalogues 845 American Standards

A revised list of standards approved to date has been published by the American Standards Association and represents 27 years of achievement in standardization for the electrical, mechanical, transportation, building, textile and other fields.

The 845 standards listed in the booklet include definitions of technical terms, specifications for metals and other materials, dimensions, safety provisions for the use of machinery, methods of work and methods of test for the finished product.

The standards are widely used throughout industry since they represent agreement on the part of maker, seller, and user groups as to the best possible practice at the time of approval. They are constantly revised to keep up with the mechanical invention, developments of power and new uses for materials.

The 154 American War Standards listed on pages 15 and 16 of the booklet, which gave vital help to the Army, the Navy, and the War Production Board, are now being reconsidered for their possible value as American Standards in connection with peacetime production.

This complete list of American Standards should serve as valuable reference material to engineers, manufacturers, sales organizations and consumer groups. It will be sent free of charge to anyone interested. Requests should be addressed to the American Standards Association, 70 East 45th Street, New York 17, N. Y.

Reducing Industrial Explosion Hazards

Danger of explosions in plants producing oxygen by the liquefaction and rectification of air may be reduced by eliminating acetylene and other hydrocarbons from the air, according to a report prepared by J. G. Aston and T.

Ashton and T. A. Geissman, Central Engineering Laboratory, University of Pennsylvania, under contract with the National Defense Research Committee.

Evidence of the explosive effect of acetylene and other hydrocarbons upon oxygen under production is scanty, according to the authors. However, the coexistence of solid acetylene and liquid oxygen at some point in operating units where explosions have occurred seems to indicate that this combination is a danger factor. The report deals with experimental methods of extracting various contaminants from air. Acetylene, the most important impurity, was removed by both catalytic oxidation and adsorption on active charcoal.

Among the contaminants mentioned as being found in small quantities in ordinary air, particularly in industrial areas, are ozone, nitrogen oxides, carbon monoxide, acetylene, and other hydrocarbons. The writers of the report emphasize the danger attending the accumulation of ozone in oxygen units.

Orders for the report, photostat $5.00, microfilm $1.00, should be addressed to the Office of the Publication Board, Department of Commerce, Washington 25, D. C., and should be accompanied by check or money order, payable to the Treasurer of the United States.

Previews of technical data descriptive in minute detail of German automotive developments were presented at the Summer Meeting of the Society of Automotive Engineers.

SAE Summer Meeting

Members of Technical Industrial Intelligence Committee teams reported that German automotive engineering practice is poorly adapted to American mass-production techniques. They explained that standardization is lacking and that many different methods are employed to solve similar problems. They said the Germans appear to love gadgets and that the German buying public readily accepts mechanical features bordering upon shortcomings which would not be tolerated by Americans.

German passenger cars generally use backbone-type frames and unit body-and-frame construction, while centralized chassis-lubricating systems, such as once were used on some American cars, were said to be found on every German car and truck. In many cases, novel suspension systems replaced rigid axles, with so-called "swinging axles" especially popular.

German engineers tend to over-design, and their vehicles are complicated in construction because limited production permits of considerable hand work.

The Germans have made more progress than Americans in developing gasoline injection pumps, but their diesel fuel injection equipment offers little that is new.

What this country needs is a good 2,000,000-mile motor bus costing not more than $20,000, the Automotive Engineers were told.

The 2,000,000-mile bus is a brain-child of World War II, operators believing that if such vehicles can give more than 1,000,000 miles of service, as proved during the war years, they can be built at reasonable cost to run the full distance. More power is needed to enable buses to maintain positions in traffic, while torque converters, or some other form of improved drive, are necessary to eliminate present difficulties with clutches and transmissions, frequent causes of road failure. Underfloor baggage compartments, two-way radio equipment, air conditioning, and auxiliary heating were characterized as additionally essential.

Aluminum alloys containing tin, nickel, silicon, and copper were recommended to the Society of Automotive Engineers as new materials for bearings which promise to accelerate progress in designing internal combustion engines.

H. Y. Hunsicker and L. W. Kempf, of the Aluminum Co. of America, Cleveland, Ohio, reported the results of extensive experiments and tests as revealing that these bearings materials are superior for high duty service in the engines both of land vehicles and aircraft. Their findings were supported by G. B. Grim, of Caterpillar Tractor Co., Peoria, Ill., and E. L. Dahlund, of Fairbanks Morse & Co., Beloit, Wis., who said aluminum-

1=14 @ 1/4 The Cost

When The Tool Is an R and L Combination Turning Tool

One R and L Combination Turning Tool, the only combination right hand and left hand tool on the market, actually does the work of 14 tools.

You can use an R and L for all these right hand or left hand applications:

- Roller Box Tool
- Centering and Facing Tool
- Knee Tool
- Pointing Tool
- Back Rest
- Floating Drill Holder
- Balanced Turning Tool

The change from right to left or vice versa takes only ten seconds.

Patented in U. S. A. and Canada

√ *CHECK THESE OUTSTANDING FEATURES*

- Made of extra tough, heat treated alloy steel; unconditionally guaranteed not to bend or give way.
- Essential parts ground to extreme accuracy affording perfect alignment at any point of adjustment.
- Back Rests, or burnishers, have almost diamond hard surfaces eliminating metal pick-up and marring of work surface.
- Interchangeable Roller Back Rests furnished if desired.
- Precise adjustment on both cutting tool and pressure of burnishers.
- Tool bits wear longer because they are ground only on top side, or end.
- Less cross-slide clearance required; saves time and often permits working with cross-slide tools while turning or drilling.
- On turnings, the R and L Combination Tool produces highly polished surfaces, true to size, and straight
- Usable either for roughing or finishing; extra heavy cuts possible because thrust is always in direct line with Back Rest.
- Longitudinal adjustment permits turning of two diameters to any length within tool capacity.

All these and many other features are shown by photographs and drawings in descriptive booklet mailed without cost or obligation. The booklet illustrates the tool set-up for various operations, and indicates speed and simplicity of its adaptation to various jobs. Prices and full specifications of many available sizes are included. Write for your copy today.

R and L TOOLS *1825 Bristol St., Philadelphia 40, Pa.*

alloy bearings appear to resist wear, as well as damage by foreign particles, and to support vastly greater loads for prolonged operating periods.

Public enthusiasm for new and radical designs should not be mistaken for desire for possession. Human psychology still is primitive and even modern man demands a link with the past. So R. E. Bingman, industrial designer, of Detroit, Mich., told the Body Session of the Sosiety.

"Man is comfortable and secure in the presence of the familiar," he declared. "He recoils in the face of the unknown. He wants neither to lead the parade nor to follow it. His exact security center is the middle, although adroit design may lead him farther to the front than he is sometimes aware."

Industrial design is part of the engineering-production-sales picture, Mr. Bingman said, and its objective is to produce a well-knit product which will have sales appeal and will function well.

"The best show-card for built-in engineering features which have mental appeal," he commented, "is a well-designed exterior which has visual oomph."

General Rules for Quenching, Tempering and Austempering

1. The useful structure in hardened pieces are bainite and tempered martensite. To obtain either of these structures, the piece is heated to secure adequate solution of carbides, and then quenched so rapidly that the formation of pearlite or upper bainite in the 1000° zone is avoided, bainite or martensite being formed then at lower temperatures.

2. When quenching a specific size of piece, the avoidance of pearlite is made easier if its possible formation would require more time. The slower rate of pearlite formation is obtained by adding alloys. If the piece is fully hardened (martensitic), the hardness is affected but little by the alloys, being governed almost exclusively by the carbon content.

3. For a given size of piece, avoidance of pearlite or upper bainite is also aided by employing a greater severity of quench. This is obtained by avoiding excess scale on the piece, by employing the quenching liquids which generally show a greater severity of quench, and by agitating either the quenching liquid or the piece being quenched. It is well to remember that the old hand agitation during quenching was very effective, and it may be desirable to duplicate the results in modern mechanized equipment.

When measuring toughness, remember that the results are affected profoundly not only by the magnitude of the stress imposed, but also by its nature and direction, and consequently also by the shape of the piece. A laboratory test should always simulate a service test as closely as possible.

5. Toughness in martensitic structures is obtained by tempering the quenched piece.

6. Bainite structures, obtained in austempering, are inherently tough and above 48 Rockwell C offer a combination of strength and toughness superior to tempered martensite.

(Summary quoted from new booklet "Suiting the Heat Treatment to the Job" prepared by Research and Technology Department, Carnegie-Illinois Steel Corporation, United States Steel Corporation Subsidiary.)

24 Years Work In SAE Spline Standard

The SAE Handbook for 1946 will include 55-page standard for involute splines representing accumulated engineering knowledge and experience of past quarter-century.

Establishing recommended dimensions and practices for device which is heart of selective transmissions and has numerous other applications, spline standard compiles findings from continuing work by automotive, tool, and production engineers, metallurgists, SAE, American Society of Mechanical Engineers, National Machine Tool Builders' Association, and others. Standard describes self-centering spline characterized by manufacturing economies, satisfactory tests and use.

HEAT TREAT SMALL PARTS

In Your Own Plant

ESSENTIAL FOR TOOL AND DIE SHOPS

You save time and money heat treating small tools and dies in a Cooley Electric Furnace. Uniform temperatures are maintained throughout the furnace chamber to assure even heating of parts. The heating elements are embedded in refractory materials, protecting against atmospheric attack. They are easily replaceable.

ECONOMICAL TO OPERATE

To hold 1600° F. in the MH-3 furnace requires less than 2 kw. At power rate of 2c per kw.-hr., operating cost is under 4c per hour. The MH-4 furnace requires less than 2.5 kw. or under 5c per hour at the same rate. Cooley Furnaces are easily installed—ready for immediate service by connecting power lines to two terminals. Quiet in operation—no fumes or odors—no ventilating necessary—they can be located at any convenient place in the shop.

More Profitable Reasons for Using Cooley Furnaces

1—Hardening, drawing and tempering small batches in large furnaces is uneconomical.

2—Small parts can be normalized and annealed quickly and easily.

3—Convenient for pre-heating prior to high-speed hardening.

4—Always available to handle emergency repair work without delay.

5—Use as a pilot furnace to predetermine techniques for production heat treating.

TWO NEW OPTIONAL FEATURES AVAILABLE

1. Vertical Lift Door—Counter weighted for ease of operation—conserves heat where door need not be fully opened to enter or remove work. Supplied in place of standard hinged hearth door at $20.00 additional to regular furnace prices shown below.

2. Heavy Gauge Steel Stand—For ease of installation and operation—locates furnace at most convenient operating height and provides additional working and storage space. Add $35.00 to regular furnace prices shown below.

AVAILABLE IN TWO SIZES

Type	Chamber Capacity	Amps 115 V	Watts	Amps 230 V	Price
MH-3	8"W 6"H 14"L	29.6	3400	14.8	$146.00*
MH-4	10"W 6"H 18"L	.....	4800	20.9	$222.50*

*Includes Hearth Plate

MAX. SAFE TEMPERATURE—Continuous operation, 1750° F.; Intermittent operation, 1850° F.

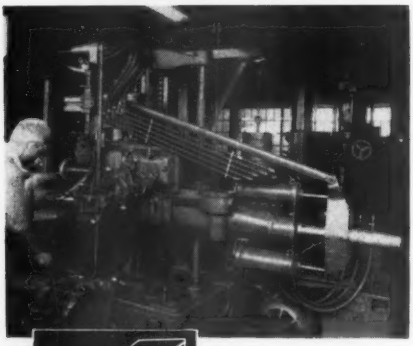
AUTOMATIC CONTROL—Indicating Controlling Pyrometer—Thermo-couple and lead wire—approximately $150.00.

NO SALESMEN WILL CALL

Ask for free information and ordering instructions so you can make your own decision and determine your own requirements. Write for Bulletin No. 50 today—no obligation.

COOLEY ELECTRIC MANUFACTURING CORP.
32 South Shelby Street Indianapolis 7, Indiana
INDIANAPOLIS MACHINERY EXPORT CORP.
Export Manager, 44 Whitehall Street, New York, New York

Why TURCHAN DUPLICATORS LEAD IN THE HEAVY INDUSTRIES!



The Turchan Hydraulic Attachment can be installed on any milling machine, lathe, planer, shaper, grinder or boring mill.

LESS HAND-WORK IN SINKING DIES

•

In the railroad, automotive, aircraft, diesel and other heavy industries, those "in the know" always turn to Turchan when they have a difficult duplicating problem.

For example, in the illustration is a Turchan sinking a die for a giant piece of railroad hardware.

Less Hand-Finishing

Working from a soft model of plaster or wood, the Turchan duplicates any desired shape with such exactness that hand-work is reduced to a minimum.

Trouble-Free Operation

Because of its hydraulic principle of operation, every moving part floating in oil, maintenance expense is practically nil. No wearing parts to give trouble! And no interference at all with the ordinary use of the machine on which it is installed, disengagement being made, whenever desired, in 5 minutes' time.

Write for Information

If you have a difficult duplicating problem, do as others are doing—turn to Turchan. DUPLICATING IS OUR BUSINESS!

TURN TO TURCHAN

TURCHAN FOLLOWER MACHINE CO.
8257 Livernois • Detroit 4, Mich.

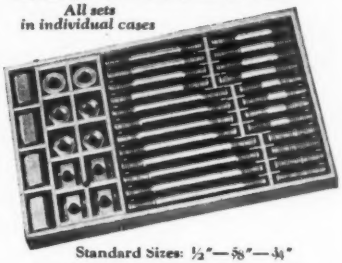
Hydraulic Follower Machine

HANDY
SET-UP STUD AND NUT SET

Saves Set-Up Time

Case hardened for long life; chrome plated for rust prevention; easy to keep clean.

All sets in individual cases



Standard Sizes: ½"—⅝"—¾"

4—3" Studs; 4—4" Studs; 4—5" Studs; 4—6" Studs; 4—7" Studs; 4—8" Studs; 4 Nuts; 4 Washers; 4 T-Slot Nuts; 4 Coupling Nuts

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Manufacturers of Tools, Gages and Their Accessories
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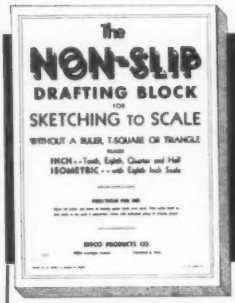

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A permanently bound block of high grade tracing paper, with the most commonly used scales always in position. No slipping—no getting out of register with drawing.

Your Speed-Draf will pay for itself—many times over—in better, more exact scale drawing, and in valuable minutes saved.

8½" x 11" ... $1.65 postpaid. ... lots of six $1.55 ea. $18.00 doz. F.O.B. Columbus, O.
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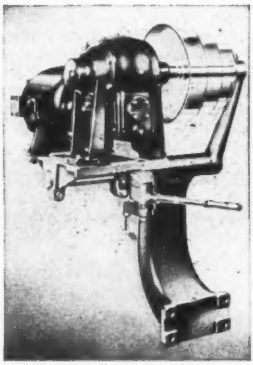

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NOW AVAILABLE TO 750 SPECIFICATIONS

Engineered for practically any machine tool . . . and guaranteed as complete units.

INCREASE PRODUCTION . . . Masterdrive efficiency helps you produce more, *faster.*

ELIMINATE LINESHAFTING . . . Masterdrives free your tools of lineshaft hazards and limitations, yet retain flexibility of belted units.

REDUCE MAINTENANCE . . . Masterdrives are powered by famous Master gear head motors, proved dependable by the 3 million now in service. And each Masterdrive is complete . . . motor and drive in a single unit.

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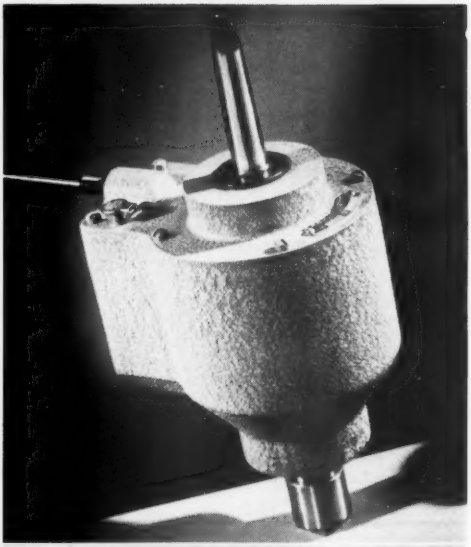
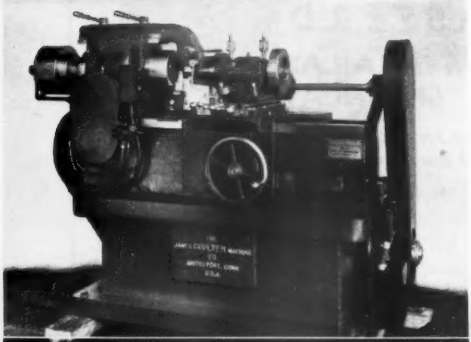
INDUSTRIAL EQUIPMENT DIVISION • DAYTON, OHIO

PROGRESS

NEW DEVELOPMENTS • IMPROVEMENTS • COST AND TIME SAVERS





FOR FURTHER INFORMATION FILL IN KEY NUMBERS ON POSTAGE-FREE INFORM-A-GRAM INSERT

DRILL PRESS TAP HEADS are designed to fit any standard drilling machine. When the tap contacts the blank, the clutch is automatically seated with cushioned effect in the drive shell, yet if the tap meets an obstruction, the clutch is designed to slip, eliminating tap breakage. When the bottom of the stroke is reached, the tap head is retracted and the tapper reverses out at twice the tapping speed. Complete specifications can be obtained from R. G. HASKINS CO., Dept. DJ, 626 S. California Ave., Chicago 12, Ill.

INFORM-A-GRAM KEY No. A70-N

HOB THREAD MILLING MACHINE. Threading of straight hand taps or taper pipe taps by the hob threading method is now possible on the Coulter Type "H" Hob Thread Milling Machine. Either eccentric or concentric reliefs can be produced on taps with any number of flutes.

For further details and specifications write THE JAMES COULTER MACHINE CO., Dept. TD, 629 Railroad Ave., Bridgeport 5, Conn.

INFORM-A-GRAM KEY No. 251-N

LIMITRON, a new limit type electronic comparator, inspects, sorts, and places each piece in the proper bin—whether oversize, undersize, or acceptable. Yellow, green and red indicating lights give the operator a double check and tell supervisors if parts are running consistently bad. It automatically counts each piece. Additional details are available from POLLAK MANUFACTURING COMPANY, Dept. DJ, 541 Devon St., Arlington, N. J.

INFORM-A-GRAM KEY No. H85-N

SAMSON GRINDING WHEEL DRESSER will dress and true any wheel now being dressed by star dressers and many others dependent on diamonds. This accurate, long wearing

ON PARADE

dresser is the result of over four years of testing and experimenting. A folder containing descriptive material is available from G. J. WALLEN MANUFACTURING CO., Dept. DJ, 617 Bryant St., San Francisco 7, Calif.

INFORM-A-GRAM KEY No. H86-N

PRECISION REAMERS. A complete new line of hand and chucking reamers—straight and spiral fluted—carbon and high speed steel—all accurate to .0002", are now available in sets of various sizes.

A bulletin containing complete information on sizes and prices will be supplied on request by N. J. DANIELS TOOL CO., INC., Dept. TD, Haverhill, Mass.

INFORM-A-GRAM KEY No. H98-N

SMALL MUFFLE TYPE ELECTRIC FURNACES are offered for industrial uses such as heat treating tools, dies, and small parts, also for laboratory testing. They may be used for drawing, tempering, normalizing, annealing, pre-heating for high speed hardening, and as pilots for inexpensive checking of heat processing cycles prior to running of larger loads in big furnaces. The maximum safe temperature for continuous operation is 1750° F.

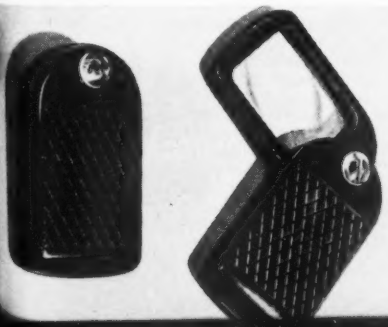
COOLEY ELECTRIC MFG. CO., Dept. DJ, 32 So. Shelby St., Indianapolis 7, Ind., will send complete specifications.

INFORM-A-GRAM KEY No. 587-N

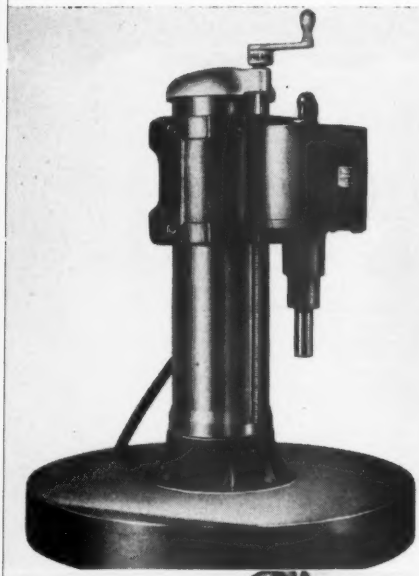
MIKROSNAP. Measuring the outside diameters of workpieces without disturbing the machine setup is facilitated by the use of a Mikrokator set in a snap gage frame. It can be set direct with Johansson Gage Blocks to any desired size, thus giving direct reading instead of "feel" as with snap gages.

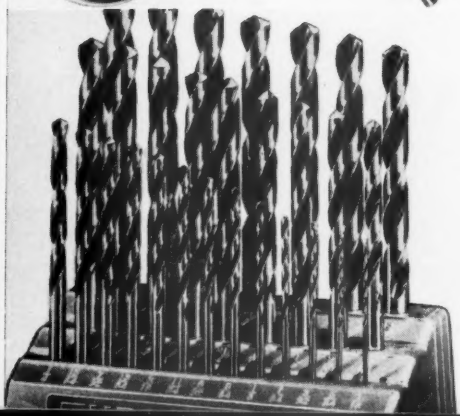
Detailed information will be sent on request by SWEDISH GAGE CO. OF AMERICA, Dept. TD, 8900 Alpine Ave., Detroit 4, Mich.

INFORM-A-GRAM KEY No. B85-N



PROGRESS ON PARADE





"MINI-MAG", THE MINIATURE MAGNIFIER, is a compact, well made unit, with rectangular shaped lens ground and polished from the very finest optical glass obtainable. In addition, it is plano-convex, so that by holding the convex side up, the distortion and aberration usually found in magnifiers is eliminated and a clear sharp field obtained. Detailed information may be secured from EDROY PRODUCTS COMPANY, Dept. DJ, 480 Lexington Ave., New York 17, N. Y.

INFORM-A-GRAM KEY No. D13-N

A NEW AIR-OPERATED COLUMN PRESS has recently been introduced, which is particularly useful for small to medium runs where it is desirable to leave fixtures permanently mounted on the base. For example, many assemblies require several stages of operations, each involving a different fixture. With the Column Press, successive operations may be quickly performed by simply swinging the ram over the desired fixture, raising or lowering it to the correct height by means of the raising screw, and locking it in place with the two drawbolts. As many as a dozen or more small fixtures may be left permanently set, ready for immediate use.

Details and specifications are available from MEAD SPECIALTIES CO., Dept. HA-56, 4114 No. Knox Ave., Chicago 41, Ill.

INFORM-A-GRAM KEY No. 569-N

STAINLESS STEEL THERMOMETER is a new instrument designed for all industry. Its all metal, welded structure is built for durability. The stainless steel stem and mounting nut are resistant to all but a few acids. Head bezel fits tightly over the gasket sealing dial. The dial is made of anodized aluminum with white figures on black background, and it is heat resistant. The figures will remain bright and legible indefinitely. Additional details may be secured from W. C. DILLON & CO., INC., Dept. DJ, 5410 W. Harrison St., Chicago 44, Ill., or use

INFORM-A-GRAM KEY No. A58-N

HIGH SPEED TWIST DRILLS. Sets of these high speed straight shank drills are now available in sturdy and convenient metal stands, as illustrated, or in folding metal containers of cadmium plated steel which can be readily carried in tool boxes. The sizes of the drills are plainly marked on the stand, in jobbers lengths from $\frac{1}{16}$" to $\frac{1}{2}$" dia by 64ths, and in wire gage sizes from No. 1 to No. 60.

Complete information on this new line of drill is contained in Bulletin No. 435 which may be obtained from THREADWELL TAP & DIE COMPANY, Dept. DJ, Greenfield, Mass.

INFORM-A-GRAM KEY No. 70-N

NEW ARO ½" DRILL, Model 7016, is built for heavy duty, continuous-production jobs requiring tool stamina and accuracy, yet it is 40% lighter than other drills of the same capacity. An auxiliary handle can be instantly located in any position around the

nose of the tool. A ⅛ counter-clockwise turn loosens the handle so it can be moved to the desired position and a ⅛ clockwise turn locks it securely in place. This feature increases its versatility for hard-to-get-at drilling jobs. It is equipped with a safety throttle trigger so it may be started and stopped with a minimum of effort. Large, heavy duty ball bearings cushion the action of all moving parts and contribute to long life. It has a speed of 1000 rpm, an overall length of 8⅝", and weighs 6¼ lbs.

ARO EQUIPMENT CORP., Dept. DJ, Bryan, Ohio, will send full particulars.

INFORM-A-GRAM KEY No. 195-N

A NEW KNEE TYPE MILLING MACHINE has been developed as the direct result of intensive experimental and research work in the application of carbide tools to a variety of milling problems. A thorough analysis of these problems led to new and advanced cutter designs. Extensive experimentation in the use of these cutters on standard models of milling machines indicated the basic requirements of machines designed for maximum efficiency when milling steel with carbides. The CSM machines were designed to meet these basic requirements, that is, increased rigidity, greater horsepower, and a more uniform flow of power to the spindle.

Detailed information on the new CSM Milling Machines will be sent on request by KEARNEY & TRECKER CORP., Dept. TD, Milwaukee 14, Wis.

INFORM-A-GRAM KEY No. 592-N

TELESCOPE FRAME FOR HYDRAULIC HIGH-LIFT TRUCK was designed by Lyon-Raymond Corporation to increase the height of the platform, making it adaptable for higher stacking and tiering jobs. This new telescopic frame increases the elevated height of the platform from the standard 48" to 84". When in lowered position the overall height is 69", allowing the truck to be moved through doorways and under overhead obstructions.

The telescopic section is of the same tubular construction as the base frame, so that added weight is kept to a minimum.

The illustration shows the truck equipped with a hand pump; however a motor-driven pump is available and is strongly recommended for any operation involving frequent elevation of the platform.

LYON-RAYMOND CORPORATION, Dept. DJ, 464 Madison St., Greene, N. Y., will furnish further details.

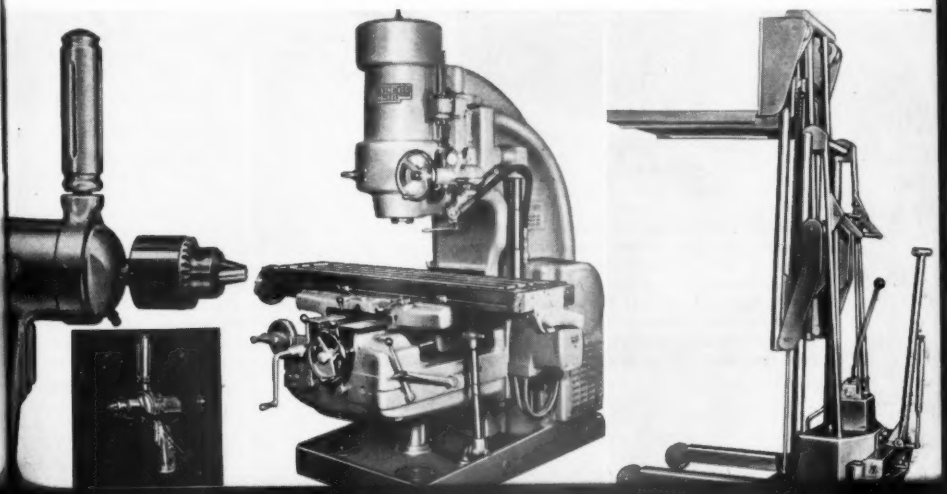
INFORM-A-GRAM KEY No. 374-N

PROLONGING THE LIFE OF DRESSER DIAMONDS has been made possible by means of a new three angle turret diamond holder

just announced. Angle settings of 30°, 20°, and 10° are obtained, so that the diamond holder can be changed from one angle to the next as the diamond nib wears.

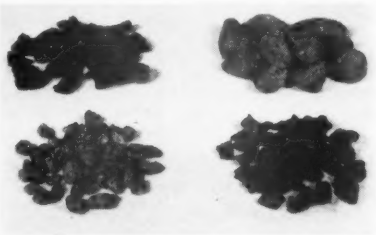
Detailed information on The Sheldon Booth Turret Diamond Holder is available from the DIAMOND TOOL CO., Dept. TJ, 938 E. 41st St., Chicago 15, Ill.

INFORM-A-GRAM KEY No. 633-N



PROGRESS ON PARADE

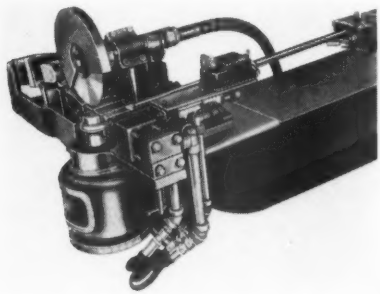
ALUNDUM ABRASIVE is a hard, heavy, tough and fast cutting aluminum oxide product for use in wet tumbling processes. It is excellent for cleaning, deburring, finishing, and the development of radii on a wide variety of metal parts. Its extreme hardness provides continuous fast cutting action without glazing over. It eliminates the variable results obtained by usual manual bench operations. Radii on gears have been held to exact blueprint specifications. Precision parts



are being consistently held to one microinch finish. It is available in four size groups, ¼" to ½", ½" to ¾", ¾" to 1", and 1" to 1½" diameters. The illustration shows the smallest and largest sizes in tumbled form and the other two sizes are untumbled (sharp corners rounded). Additional information may be secured from the NORTON COMPANY, Dept. DJ, Worcester 6, Mass.

INFORM-A-GRAM KEY No. 545-N

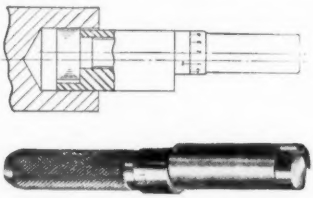
AUTOMATIC CUT-OFFS FOR PINES BENDERS of all 6 sizes are now available from



PINES ENGINEERING CO., Dept. DJ, Aurora, Ill. Pines benders accommodate tubing of from ¾" to 5" O D, and pipe of up to 4" O D. Shown herewith is a No. ¾ Pines Hydraulic Bender equipped for fully automatic manufacture of return bends or elbows. Both the Pines patented booster and cut-off attachments are used. To start the bender's operation a piece of tubing is placed over the mandrel, then the "start" control is pressed. After the tubing has been bent by the machine, the mandrel is extracted. Finally, before the clamps are released, the hydraulic powered saw cuts through the tubing.

INFORM-A-GRAM KEY No. 426-N

DIRECT READING BORE GAGE. The Comal gage is designed for checking bore diameters and gives a direct reading in thousandths or "tenths" of the plus or minus variation from "basic" of a given bore diameter. It operates as an expandable, direct reading plug gage. Measuring is done by the main body of the gage and a constant rise, radius member, the two being expanded to bore diameter by the micrometer thimble type of handle which is calibrated in thousandths or "tenths". The gage may be used for deep bore gage and will give readings of taper throughout the length of a bore, as well as



of major and minor diameters in the case of an out-of-round condition.

The Comal gage may be had for checking bores of ½" diameter and up, and in a variety of maximum measuring ranges of from .003" to .012". In each range a variety of calibrations may be had in relation to basic, i.e., style B, with a maximum measuring range of .009" may be calibrated to read, for example, plus .003", minus .006" or plus .002", minus .007" or plus .004", minus .005".

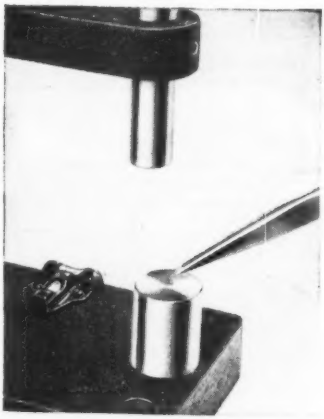
Additional details may be obtained from THE COMAL GAGE & MACHINE CO., 2819 Jay Avenue, Cleveland 13, Ohio, or by use of our postage-free

INFORM-A-GRAM KEY No. H83-N

MAGNETIC HARDNESS TESTERS for rapidly and accurately gaging small, ferrous metal parts are announced by the METER & INSTRUMENT DIV., GENERAL ELECTRIC CO., Dept. DJ, West Lynn, Mass. Parts too small for mechanical hardness testing are easily accommodated by this gage. It is also valuable for spot checking the hardness of large sheets or lengths of steel wire. By means of this gage, pieces of unknown hardness are comparison checked against pieces of known hardness. Without harming a test piece, its differences

of as slight as 2 points on the Rockwell "C" scale are distinguished by this gage.

INFORM-A-GRAM KEY No. G69-N



PIPE TAP EXTRACTORS are made especially for the quick, accurate and easy removal of broken pipe-threading taps. The extractor fingers are inserted into the flutes of the

broken tap and pushed firmly into position. Then the holder is pushed down until it touches the broken tap, and the sleeve is slid down until it contacts the work. By applying a tap wrench to the square end of the holder and firmly but gently twisting it backward and forward a few times, the broken tap can be loosened and backed out.

These extractors are available in all sizes from ⅛" to 1" inclusive. THE WALTON COMPANY, Dept. DJ, 94 Allyn St., Hartford 3, Conn., will send full details.

INFORM-A-GRAM KEY No. B82-N

PORTABLE SHAPER for quickly moving from job to job as needed saves steps, time and floor space. A 7-inch AMMCO shaper is mounted in a new portable cabinet, provided with casters and a folding handle which compactly drops out of the way when not in use.

Additional information may be requested from AUTOMOTIVE MAINTENANCE MACHINERY COMPANY, Dept. DJ, 2100 Commonwealth Ave., North Chicago, Ill.

INFORM-A-GRAM KEY No. 197-N

REVERSIBLE THREAD PLUG GAGE. Wear on thread plug gages is never equally distributed over the entire gaging surface, experience showing it to be concentrated on the first 5 or 6 threads. For this reason, worn thread plug gages are often discarded when only the entering threads are worn beyond tolerance. The Reverso-Gage, a new chrome carbide type, provides a reversible gaging element which, when worn beyond normal limits, can simply be backed off the shank, turned end for end and locked in place.

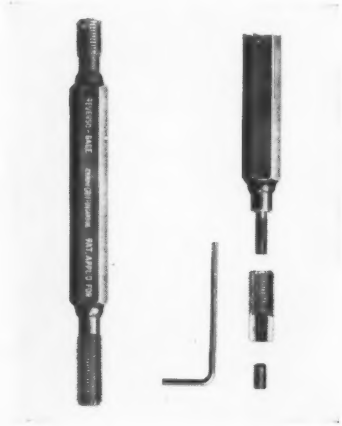
The Reverso-Gage is made in two pieces, a shank and gaging blank. The gaging blank is of mild steel, the center being drilled and tapped. The outer surface is coated with a layer of chrome carbide alloy, and the gaging threads ground into the solid coating; thus the entire thread is formed of chrome carbide. This gage blank screws on to the shank and is locked by an Allen screw.

For further details about this gage, write

PROGRESS ON PARADE

GEORGE O. GRIFFIN CO., Dept. TD, 1301 W. Hadley St., Whittier, Calif.

INFORM-A-GRAM KEY No. C9-N



ONE CUT FINISHING REAMERS for quickly producing satin-smooth surfaces are known as patented Evans Dual Spiral Reamers, introduced by EVANS REAMER AND MACHINE CO., Dept. TD, New Lexington, Ohio. In their design these reamers incorporate 2 left-hand

fluted, high speed steel cutting blades with a third one being counter-spiraled. All three blades cut simultaneously. No honing is required by Dual Spiral Reamers with their expansion rate of from .035" to .080".

INFORM-A-GRAM KEY No. 733-N

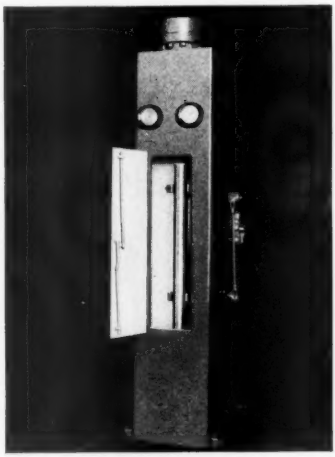
NON-ROTATING HYDRAULIC CYLINDERS deliver fast, smooth, dependable power. They are designed for low pressures up to 750 psi and high pressures from 750 psi to 2000 psi, and range in sizes from 1½" to 8" bore.

They are available in 7 standard mountings and with any length of stroke to meet individual requirements.

Detailed information may be obtained from ANKER-HOLTH MFG. CO., Dept. DJ, 2735 Conners St., Port Huron, Mich.

INFORM-A-GRAM KEY No. 925-N

A TUBE TESTING PRESS of the hydraulic type and 25 ton capacity has lately been introduced by BEATTY MACHINE AND MFG. CO., Dept. TJ, Hammond, Ind. This new unit employs hydro-static internal pressure of up



to 4800 lbs psi and an 8" stroke impelled at a speed of 34" pm and retracted at the rate of 68" pm. The throat depth is 6"; the length of daylight space provided, 57". Tubes with 3¼" I D and 48" long represent the maximum capacity of this press.

INFORM-A-GRAM KEY No. H49-N

REVOLVING STOPS for automatic screw machines are a new addition to the line of screw machine tools produced by THE ALCO TOOL CO., Dept. DJ, Birdseye St., Bridgeport 4, Conn. Makeshift stationary stops which

OPERATING TOOLS CAN MOVE FREELY OVER WORK HELD BY THESE CLAMPS

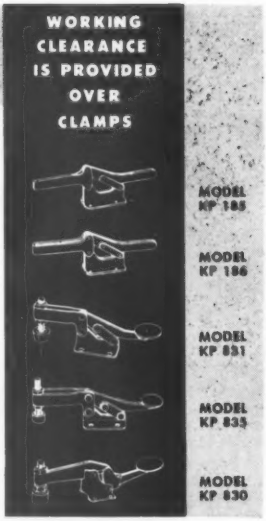
All these models assume a low, horizontal position. There are no obstructing handles to interfere with free movement of drills passing over clamped work. There is a size to meet every need.

MODEL KP 185 has solid bar.

MODEL KP 186 provides channel for positioning pressure spindle.

MODEL KP 831 and KP 835 are mighty midgets with incredible strength. Hold materials up to ¾". Both have channel bar to permit range of lateral spindle adjustment.

MODEL KP 830 has solid bar.



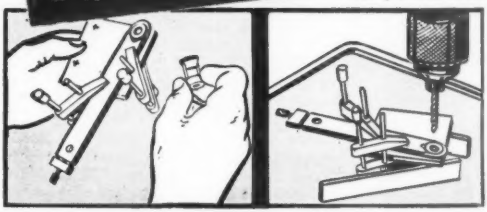
KNU-VISE INCORPORATED

1330 PLUM ST. DETROIT 16, MICH.
4328 SAN FERNANDO RD. GLENDALE, CALIF.

DRILL HOLES within .001 ACCURACY

MASTER OPTICAL CENTER⊕LOCATOR

QUICK! ACCURATE! Machinists who use the Center-Locator claim that it is the simplest, speediest, most accurate method of locating centers and drilling holes on the market. It actually makes a drill press do the work of a jig boring machine! Drill jigs, piercing dies, mold, templates, metal patterns and machine parts demand an accurate relationship between a series of holes—as well as close tolerances between the centers of these holes and other points. The Center-Locator, with its powerful magnifier, performs this function quickly and accurately. *How it operates:* Lay out work with height gauge, locate center through the magnifier—then replace magnifier with any of 16 drill bushings furnished. Ask your mill supply house, or $34.00, postpaid.



Literature on request.

MASTER SPECIALTY CO.

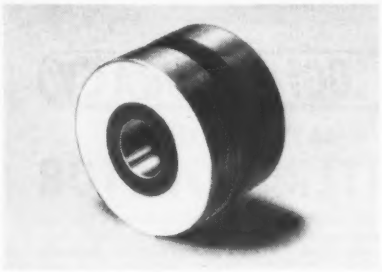
3012 E. Lake Street Minneapolis 6, Minn.

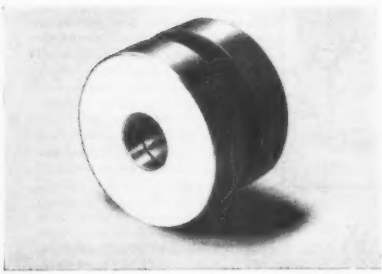
create extreme friction, thus marring work ends, are supplanted by the not only more efficient but less expensive Alco revolving stops.

By positive and easy action, Alco revolving stops maintain length accuracy on long production runs. Alco stops are from 3" to 6" in overall length, with shank diameters of from 5/8" to 1 1/2", and head contact diameters of from 3/8" to 1 1/2".

INFORM-A-GRAM KEY No. 180-N

CARBIDE-INSERTED COMPACTING DIES, being used by one manufacturer, have produced approximately twenty times as many tablets as with steel dies formerly used. The top illustration is one of sixteen dies which have produced over fifty million tablets with no sign of wear, averaging 3,500,000 tablets per die without reversing. Also, no presses have been down because of wear or die failure. The lower illustration shows a steel die which produced 150,000 tablets





by using both ends. The carbide dies have the additional advantage of giving better surfaces to the tablets, with the elimination of lubricating difficulties.

For detailed information on this material known as "Malta", write the JESSOP STEEL CO., Dept. TD, Washington, Pa.

INFORM-A-GRAM KEY No. 259-N

CARBIDE TIPPED CYCLONE DRILL-BITS for drilling holes in concrete, cement, brick, tile, marble, and other masonry materials are announced by THE NEW ENGLAND TOOL CO., Dept. DJ, 60 Brookline St., Cambridge, Mass. Carbide, through maintaining its cutting edge when running hot, is ideal for tipping

Cyclone Drill-Bits. One user of this type bit reported drilling a group of holes in a brick wall within 80 minutes whereas the same job performed by his formerly used method would have required 8 1/2 hours. Cyclone Drills are made in stock sizes of sixteenth steps from 3/16" to 1 1/2" in dia.

INFORM-A-GRAM KEY No. 58-N

BATCH TYPE CORE BAKING OVENS daily turn out five times more cores and have lowered production cost by 40 percent since they were installed by the South Park Foundry and Mfg. Co., South St., St. Paul, Minn. This direct gas fired Despatch oven has not only increased production 500 percent, it has also eliminated green cores, has totally cleaned the core room, and completely automatized the process of core baking. It is marketed by the DESPATCH OVEN CO., Dept. TD, 619 S. E. Eighth St., Minneapolis, Minn.

INFORM-A-GRAM KEY No. H43-N

POWER FEED For Facing

BORING, TURNING, FACING, UNDERCUTTING, COMBINED IN ONE TOOL HEAD

The power feed feature for facing operations insures smooth, uniform movement of tool across work surface. This power feed can be engaged or disengaged instantly. Adjustment of tool for boring is obtained in increments of 1/10,000 in direct reading.

All Operations In One Set-Up

For Jig Borer, Drill Press, Milling Machine

Pat. No. 2,356,651

MADE IN FOUR SIZES

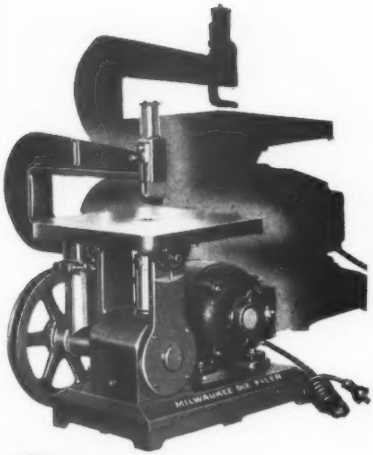
Cutting bar can be set to any position in Tee slot of slide. Hardened and ground throughout. Feed screw and worm ground from solid. Gears and feed nut phosphor bronze. Head 3" dia. x 4" long. Wt. 9 lb. Any type shank furnished. Write for complete information.

CHANDLER TOOL CO.

514 OHIO AVE. MUNCIE, IND.

CHANDLER DUPLEX

BORING AND FACING TOOL HEAD



Designed FOR CLOSE-LIMIT SAWING

Tool and Die Makers like the Milwaukee Die Filer for two basic reasons:

1. The Saw Overarm and File Roller Support Arm are easily interchanged in a few minutes... reducing set-up time to a minimum.
2. Sawing is done to extremely close limits . . . leaving very little metal for subsequent filing.

The net result is fast, clean, accurate workmanship that really "steps-up" tool and die fabrication.

NEW SAFETY GUARD

One-piece, all-metal guard now available to all owners and purchasers of the Milwaukee Die Filer, at slight extra cost. Easily installed, it gives operator complete protection, yet does not interfere with speedy shifting of drive belt.

Milwaukee

CHAPLET & MANUFACTURING CO.

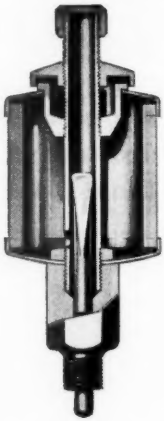
1029 S. 40th ST., MILWAUKEE 4, WIS.

PROGRESS ON PARADE

JAM-PROOF, NON-RELEASING TAP HOLDERS of a new draw-out style are introduced by BARNABY MFG. & TOOL CO., Dept. DJ, Bridgeport, Conn. Ruggedly constructed, this tool neither sticks nor jams with the severest tapping use. Any slight machine mis-alignment is compensated for by this tap holder's slight amount of float, while two free-sliding cylindrical guide keys safeguard its trouble-free operation. Concerning these tap holders, further information in an illustrated bulletin is available from their producers.

INFORM-A-GRAM KEY No. G72-N

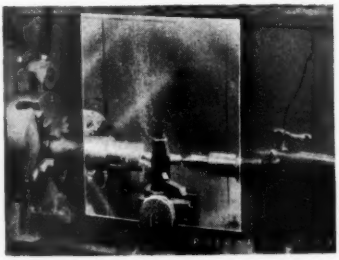
VIBRATION AND HEAT are the operating principles of the new Vibrating Rod Bottle Oiler. Constructed of brass and Lucite, this oiler is used on plain sleeve bearings, line shaft bearings, jack shafts, and spindles. It is particularly suited for dusty surroundings, such as on grinding machines, to prevent dust and chips from getting into oil holes. Oil is fed from an airtight reservoir through an oil port to a feed rod which slides freely in a closely fitted hole in the base and rides lightly on the journal. A slight vibration is caused by the directional drag of the rotating shaft on the feed rod, resulting in a pumping action.



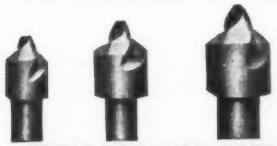
Complete details for all applications will be furnished by OIL-RITE CORP., Dept. TJ, 3432 South 13th St., Milwaukee 7, Wis.

INFORM-A-GRAM KEY No. J7-N

THE HORSESHOE PERMANENT MAGNET has come to the aid of the production manager and plant safety chief through the development of the Magnetic Grip-Shield. Because of the ease of positioning the shield and the clear vision afforded without discomfort to the machine operator, the breaking of safety regulations is materially reduced. This shield is made up of a horseshoe magnet permanently attached to a transparent sheet, either flat or shaped to specifications. The magnet anchors the shield to the machine frame and the plastic sheet prevents flying hot chips from reaching the operator, guarding him against eye and body injury. Literature



write for Discounts and Bulletin No. 451



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GROBET FILE CO. of AMERICA • 421 CANAL ST. NEW YORK CITY

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The most complete catalog of its kind. Lists 5000 different shapes, sizes and cuts of GROBET Precision Swiss Files. Ask also for catalog YM on files for filing machines.

Learn more about these Chrome Steel Files that have won a reputation for utmost precision and durability—since 1812.

GROBET FILE CO. OF AMERICA, 421 Canal St., New York 13, N. Y.

GUILD Reamers

HALLMARK OF Precision IN THE MANUFACTURE OF Special Reamers

HIGH SPEED STEEL
in sizes from .025 diam.

CARBIDE TIPPED
in sizes from .090 diam.

STRAIGHT • SPIRAL • STEP • PILOT • HAND

● GUILD is the new name for an old established line of reamers whose reputation for accuracy has become outstanding in the manufacture of aircraft—motors—engines—small arms—radios—fine instruments, etc. The name GUILD is stamped on each individual reamer as an identification—a hallmark of finest quality. Quality that is possible only by *creative* and *productive* ability far above the average in the manufacture of *reamers specially built for special purposes.* Write for booklet.

METAL CUTTING TOOLS AND MANUFACTURING CO.
3946 W. Eleven Mile Rd., Berkley, Mich.
• Phone: Lincoln 2-5600 •

What STERLING is to silver GUILD is to Reamers

giving designs and applications are available from THE DILLEY MANUFACTURING CO., Dept. TJ, 10111 Euclid Ave., Cleveland 6, Ohio.

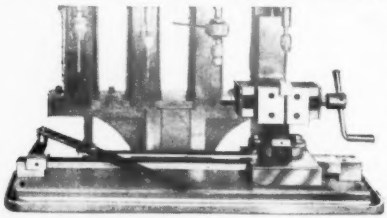
INFORM-A-GRAM KEY No. J2-N

NEW ELECTRICALLY HEATED OXIDIZING TANKS provide steel parts with a deep hued, uniform blue-black finish which resists rust and will not rub off, peel, crack, or chip. The

tanks are introduced by D. C. COOPER CO., Dept. TJ, 1467 South Michigan Ave., Chicago 16, Ill. Equipped with a thermometer and a thermostat for accurate control of temperature, the D. C. oxidizing tank is built of heavy gauge steel. Both high and low temperature ranges are furnished this tank by its side (two) and bottom positioned heating elements. Each of them has its individual switch and pilot light and may be operated independently of the other heating elements.

INFORM-A-GRAM KEY No. G89-N

TIME CONSUMING JIG LOADING is facilitated on multiple spindle drill press operations performing drilling, tapping, reaming,

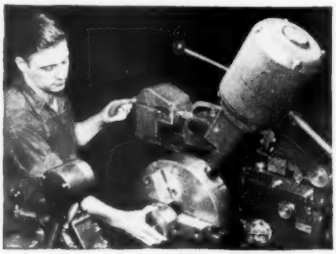


and counterboring through use of the "Split-Second" jig alignment carriage. This newly designed equipment permits shifting the holding jig quickly from spindle to spindle and eliminates the rechucking of the work-piece. Thus, greater accuracy, simplified operation, and reduced production cost are obtained.

Detailed information and specifications will be sent on request from HEUSER MFG. CO., Dept. TJ, 1638 N. Paulina St., Chicago, Ill.

INFORM-A-GRAM KEY No. J6-N

AUTOMATIC WRENCH consists of a motor-driven wrench designed to fit the sockets of the particular chuck being used. The wrench head is introduced into the socket, the jaws tightened or loosened, and then withdrawn by means of a convenient hand control at the operator's left hand. Tension of the chuck jaws is controlled by the operator's touch; a light touch for thin walled pieces to prevent



distortion and a heavy grip to hold heavier work. The operator's right hand is always free for handling the work-piece. This wrench will move the chuck jaws to the full extent of their travel and are adaptable to any size machine. Detailed information is available from the FEN MACHINE COMPANY, Dept. DJ, 1322 Babbitt Rd., Cleveland 17, Ohio.

INFORM-A-GRAM KEY No. H95-N

THREAD & GASKET SEALING COMPOUND. Uniseal, a new organic product, produces a high efficiency seal which is proof against air, water, steam, gas, gasoline, hydraulic fluids and aromatics. Uniseal is available from PARKER APPLIANCE CO., Dept. DJ, Cleveland, Ohio. Thorough tests of Uniseal have shown its insolubility in gasoline, kerosene, Stoddard solvent, benzene, xylene, carbon disulfide, the ketones, acetones, and the various aromatic aviation fuels. Uniform in consistency, this organic product contains no free metallic particles which galvanic action may render corrosive, or other additives subject to washing out. Smoothly flowing Uniseal forms ribbon gaskets and blends readily with cut gasket material. Easy to use and anti-seize of nature, Uniseal is a necessity for threaded fitting assembly. It is procurable in from 8 oz tubes to 5 gal containers.

INFORM-A-GRAM KEY No. G76-N

SHOP AIDS

For You And Your Job

Use our postage-free Inform-a-Gram for your requests.

METAL CUTTING TOOLS applicable to the metal working industry are listed in a new catalog published by Lafayette Tool & Supply Co. Each type of tool cataloged is illustrated and described. Most of the items are nationally advertised, thus wanted tools are easily located. Listed, in addition to cutting tools, are gages, gage blocks, punch presses, tool and surface grinders, and many machine tool accessories.

Copies of this catalog are available on request from Lafayette Tool & Supply Co., Dept. TJ, 128 Lafayette St., New York 13, N. Y.

INFORM-A-GRAM KEY No. J3-N

"COATED ABRASIVES IN THE PLASTICS INDUSTRY", a new industrial service booklet by Behr-Manning, treats plastics from the "sanding" angle. In addition to explaining abrasive selection, machinery and equipment, buffing, and polishing, the first half of the booklet is devoted to an introduction and simplification of the plastics themselves. This introductory section clarifies much of the confusion resulting from the hundreds of plastics names by combining similar materials into seven, easily recognized family groups.

Accompanying the booklet is a large 17" x 22" three-color chart enlarged from the center spread of the booklet and listing complete reference data on 70 of the popular rigid type plastics.

To obtain copies of this booklet write Behr-Manning Corp. (Div. of Norton Company), Dept. TJ, 1933 Sidford Street, Troy, N. Y.

INFORM-A-GRAM KEY No. 110-N

"A TREATISE ON MILLING AND MILLING MACHINES" describes in a general way the function and operations of milling machines as well as the cutting tools used for performing milling operations. Typical milling examples, illustrating actual equipment installed in manufacturing plants, are suggestive of proper fixture and work chucking devices, as well as the most economical cycle of operations.

The chapters on materials for cutting tools, sizes, styles, and shapes of the milling cutters, are based on latest and very extensive metal cutting research, which has been one of the major functions of the Research Department of The Cincinnati Milling Machine Co., under the direction of Mr. Mario Martellotti, Research Engineer.

This 182-page book is Section One of "A Treatise On Milling and Milling Machines"; other sections will follow later.

Copies can be ordered from the Cincinnati Milling and Grinding Machines, Inc., Dept. TJ, Cincinnati 9, Ohio. Price $1.00, remittance with order.

"PLASTICS MOLD ENGINEERING" is a 494-page book by J. H. DuBois and W. I. Pribble that should be particularly helpful to those who are just entering the plastics field and who wish to make a serious study of the various phases of this important science. It sets forth the fundamentals of plastic mold design and mold construction. The construction methods most commonly employed are fully explained, since best results are obtained when molds are designed for toolroom equipment that is widely available. Reference tables, useful to mold designers, are included to provide essential data to both student and designer. It is illustrated with numerous photographs and drawings, and should fill a much felt need in the Plastics Industry.

Copies are available from the American Technical Society, Dept. DJ, Drexel Avenue at 58th Street, Chicago 37, Ill. Price $7.00.

"METCO NEWS", a house organ published quarterly by Metallizing Engineering Co., Inc., contains briefs from industry on the latest developments and applications of the metal spraying process. For instance, in the current issue, there are articles discussing metallizing paper machine breast rolls; armoring punch press rams against breakage; salvaging gauges at low costs; spraying wildcats; and metallizing collector rings cuts street car power loss.

A copy of their April, 1946, issue may be requested from Metallizing Engineering Co., Inc., Dept. DJ, 38-14 30th St., Long Island City 1, N. Y.

INFORM-A-GRAM KEY No. 390-N

SHOP AIDS

"MACHINE TOOL WORK" by William P. Turner and Halsey F. Owen, second edition, offers a systematic course of instruction in the fundamental principles of machine tool work for groups of students or individuals.

This 364-page clothbound book contains 24 chapters dealing with the setup and operation of machine tools, safety in shop, materials, cutting speeds and feeds, measuring devices, screws and screw threads, gear and gear cutting, kind of fits and fitting. One chapter is devoted to problems for the beginner in machine tool work. This easy-to-understand, illustrated book may be obtained from the McGraw-Hill Book Company, Dept. DJ, 330 West 42nd Street, New York 18, N. Y. Price $1.25.

HYCC TOOL STEEL DATA SHEET issued by Crucible Steel Company of America lists: the chemical analysis of this steel; typical applications; critical temperature; procedure for forging; annealing; hardening; and tempering. It also gives Rockwell C hardness obtainable at various tempering temperatures.

HYCC is a high carbon, high chromium tool steel particularly adaptable for the making of blanking dies and punches from which long production runs are required. Due to its wear-resisting property, this steel is likewise adaptable to high production forming operations.

For copies of this data sheet, write Crucible Steel Company of America, Dept. TJ, 405 Lexington Ave., New York 17, N. Y.

INFORM-A-GRAM KEY No. 256-N

"SETTING UP AN APPRENTICESHIP PROGRAM" is a guide to employers in training veterans for the skilled trades. It has been published by the U. S. Department of Labor in answer to demands for a comprehensive explanation of how to establish an apprenticeship program and the procedures under the "G. I. Bill."

The booklet explains in detail how to determine the various provisions to include in an apprentice training program, as well as the steps an employer must take to obtain approval as a qualified "training institution" for veterans, and the steps a veteran must take to derive the benefits of the "G. I. Bill."

Copies of this booklet are obtainable by writing to Apprentice Training Service, U. S. Department of Labor, Washington 25, D. C.

INFORM-A-GRAM KEY No. 823-N

"CHANGING THE SHAPE OF METAL WITH AN ENGINE LATHE", a new book just published by the Shell Oil Co., is not just another textbook for machine-tool workers and is not intended to teach anyone how to operate a lathe. Instead, it is designed to make clear why the lathe operates as it does. While the book is simple enough for beginners, it contains material of value to experienced machinists, instructors and shop superintendents as well.

The fundamental features of different lathe operations such as turning, boring, facing, and threading are discussed, with particular emphasis on why they are performed as they are. Such fixed factors as machine design and tool shape, and such operating factors as tool setting, depth of cut, speed of workpiece, and rate of tool feed, are briefly explained.

The book is written simply, concisely, logically. It contains 160 pages including over 500 charts, photographs and drawings, many of them in two and three colors.

The book is available from the Shell Oil Co., Inc., Dept. TJ, 50th St., New York 20, N. Y. Price $7.50.

SUITING THE HEAT THEATMENT TO THE JOB. Of particular interest and value to the younger metallurgists and to all heat treaters, as well as to production engineers and designers, is the simple, straight-forward discussion of the fundamentals of heat treatment just prepared by the Research and Technology Department, Carnegie-Illinois Steel Corporation, United States Steel Corporation Subsidiary, 429 Fourth Ave., Pittsburgh 19, Pa. This 2-color, 8½" x 11" wire bound 54-page booklet, effectively illustrated with clearly explained charts, diagrams and photographs, devotes 26 pages to factors concerning Hardness, covering heating, pearlite, bainite, martensite, S-curve, hardenability, and quenching. The next 26 pages relate to Toughness, covering such factors as tempering, shape of piece, notch-bar, austempering, stresses, and cracking. Six concise fundamental statements summarize the detailed explanations, and a valuable table of Jominy end quench distances vs bar diameters for six different quenching conditions concludes this new booklet. Copies may be secured from any office of American Steel and Wire Company, Carnegie-Illinois Steel Corporation, Columbia Steel Company, National Tube Company, or Tennessee Coal, Iron and Railroad Company, or by use of our

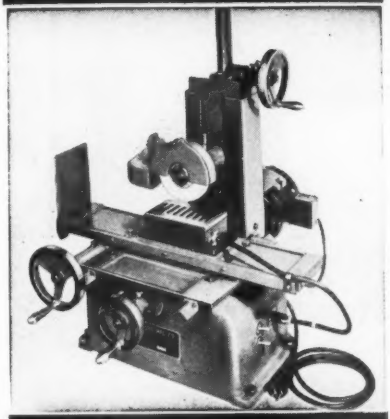
INFORM-A-GRAM KEY NO. 925-N

"MASS PRODUCTION OF MASSIVE PARTS". This new 16mm sound and color motion picture portrays the possibilities of fabricating very heavy parts for equipment of all kinds by means of Thermit welding. It shows the methods employed during the war by the California Shipbuilding Company in building thousands of 40-ton stern frames for cargo ships.

Prints are available without charge from the Metal & Thermit Corporation, Dept. DJ, 120 Broadway, New York 5, N. Y., for showing to engineering and technical societies, as well as industrial concerns.

INFORM-A-GRAM KEY No. H46-N

SANFORD



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A sensitive machine built to rigid standards of accuracy and workmanship specially designed *"For the job that fits in your palm."*

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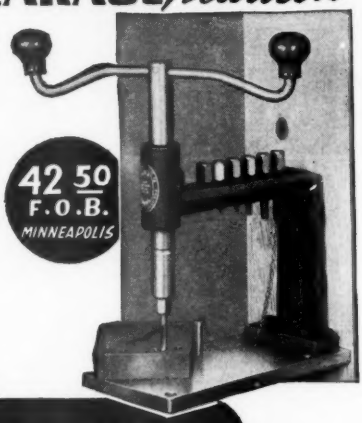
TAP BREAKAGE *Reduced*

Square, Straight Tapping in Half the Time

The Dahlstrom Tap Guide practically eliminates tap breakage and saves wasted hours getting broken taps out of expensive dies. It does the job in a jiffy with work always straight and true. Just fasten it to a post or bench, slip a Tap Adaptor into the spindle, and even an inexperienced operator can handle it. Equipped with 7 Adaptors, ranging from 8-32 to ½". Taps not furnished. Ask your mill supply house, or $42.50 F. O. B. Minneapolis. *Literature on request.* Dahlstrom Manufacturing Co., 422 South Sixth Street, Minneapolis 15, Minn.



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for **PEACETIME PROFITS**

With Dickerman Hitch Feeds for your punch presses, you'll get top production at rock-bottom cost. They are accurate, reliable and easily changed from one die to another. Send now for descriptive booklet.

DICKERMAN HITCH FEEDS

H. E. DICKERMAN MFG. CO., 321TD Albany St., Springfield, Mass.

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Original Accuracy *Maintained*

Noted for maintaining original accuracy over a longer period. Criterion Heads are smooth, compact, rigid. Parts subject to wear are hardened. Lead screw is hardened tool steel, with threads ground from solid after hardening. All heads have large, graduated dial. Large offset adjustment eliminates need for offset boring bars. Two sizes: 1½" and 3". ½" and 1" bar capacity. Shanks are interchangeable, enabling operator to use head on different machines. Ideally adapted for slide boring tool holder on small turret lathes. Ask your dealer or order direct. Request free literature.

Lead Screw ground from solid AFTER hardening.

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BEVERLY HILLS, CALIFORNIA

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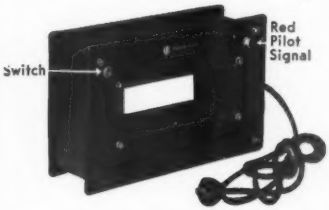

No shop or toolroom can afford to be without one. Thoroughness of the AMC Demagnetizer will give greater precision to finished parts.

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The worm drive costs more, but is used exclusively on the Kalamazoo because it operates more smoothly and with a minimum of wear.

This worm gear runs silently in a bath of oil, completely housed against chips or foreign matter. Note too, that Timken Bearings are used on both drive shaft and gear shaft. Years of trouble-free service is assured for this drive mechanism.

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Kalamazoo *Metal Cutting* Band Saw

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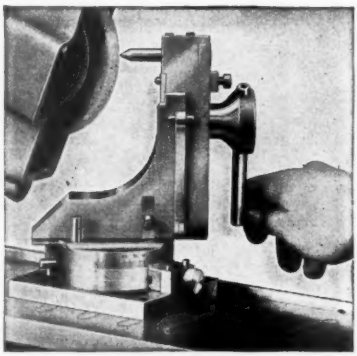

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TAP GUIDE practically eliminates breakage, cuts hand tapping time more than 50%, and turns out a job that is always straight and true. These units can be fastened to the wall, post, or bench and are easy to operate. All tap guides are equipped with 7 adaptors, ranging from 8/32" to ½". Literature may be requested from DAHLSTROM MANUFACTURING CO., Dept. DJ, 420 So. 6th St., Minneapolis 15, Minn., or use our

INFORM-A-GRAM KEY No. H92-N

TOOL HOLDER INSURES POSITIVE GRIP. The exclusive feature of this new tool holder is a clamping pin which engages nearly the entire length of the bit or blade. A light pressure of two setscrews on this pin locks the tool bit or blade rigidly in place, absolutely preventing slipping. A dowel holds the clamping pin in place when the blade is removed. There are no broken bits from setscrew pressure. Heavier cuts at higher speed and feed are possible. Bulletin 102-TH is available from Industrial Tool Division of THE COOPER-BESSEMER CORPORATION, Dept. DJ, Mount Vernon, Ohio, or use our

INFORM-A-GRAM-KEY No. 85-N

NORELCO DIAMOND DIES are amply illustrated and described in an 8-page booklet, B-1049. The text explains window method for precision drilling and tells how diamond dies are made for modern industrial applications. Steps in making the indenture, the cone, and the channel are detailed with text, drawings and photos. Differences in dies designed for hard, half-hard and soft wires are outlined. Techniques of polishing, recutting and setting are explained in detail. There are tabulations giving the points to look for in selecting good dies together with the types of dies to avoid. NORTH AMERICAN PHILIPS COMPANY, INC., Dept. DJ, 100 East 42nd St., New York 17, N. Y., will send a copy of this booklet.

INFORM-A-GRAM KEY No. B1-N

HYPER-DRILLING is a new technique for drilling holes in metal. The basic principle is the ultra-rapid removal of chips immediately on formation. A jet of coolant, in great volume and at high pressure and speed, is conducted right down to the drill point, and out again, carrying the chips with it. A ⅜" hole, 4" deep, can be drilled in 5 seconds with this new "Jet" drill and "Jet" director. A copy of Bulletin J-2, giving complete speci-

fications, may be obtained from REPUBLIC DRILL AND TOOL COMPANY, Dept. DJ, 322 So. Green St., Chicago 7, Ill.

INFORM-A-GRAM KEY No. 440-N

MACKAY PRECISION TRUERS eliminate the waste motion involved in attempting to true up work by the "trial and error" method. With this device, work can be trued up to a concentricity of .0005" or better in a few seconds. A folder, containing diagrams and instructions on the applications of this Precision Truer is available from MACKAY MACHINES MFG. & SALES CORP., Dept. DJ, 1047-53 47th Road, Long Island City 1, N. Y.

INFORM-A-GRAM KEY No. G23.5-N

LIBERTY PLANERS enjoy an international reputation as fast-operating, heavy-duty machines. Some of their features are: motorized automatic rail clamping; dual control (either side of machine) for rapid traverse, elevation, clamping; vertical and horizontal feed to side heads, rapid traverse to both; rapid traverse to all heads independently and simultaneously through individual controls; side head clapper box in same line as rail head clapper box; and automatic safety features. Bulletin 157, giving complete descriptions of these planers, is available from LIBERTY PLANERS, INC., Dept. DJ, Hamilton, Ohio.

INFORM-A-GRAM KEY No. 366-N

TOOL GRINDING FIXTURE is an improved, adjustable tool holder for holding cutting tools in any desired position so the grinding wheel will grind the precise cutting angle

required. The cutting angle is obtained by means of graduations on the circular disc. The unique feature of this device is the tilting block which is held on a shaft attached to the base casting. By tipping the block, four different clearance angles on the cutting tool, 3°, 5°, 7°, and 10°, are obtained. The base has four separate contact points which are lapped to correspond to the four angles on the rotating block. It holds all types of tool bits from ⅛" to 1¼". Inside and outside threading tools can be accurately ground. GEO. SCHERR CO., INC., Dept. DJ, 200-B Lafayette St., New York 12, N. Y., will send full particulars.

INFORM-A-GRAM KEY No. 490-N

CENTER SCOPES are "time savers" for all tool and die makers and of the utmost value to machine operators in all their jobs of locating points. These instruments are introduced by CENTER SCOPE PRODUCTS, Dept. TD, 3829 San Fernando Rd., Glendale 4, Calif. Locating lay-outs or lining up workpiece edges and hold centers to any spindle's axis are all facilitated and accuracy is assured by use of the Variable Center Scope. Furthermore, its use greatly increases the applicability of any height gage by providing for optical precision checking methods. Besides being adaptable to any special machine tools such as lathes and drill presses, the Center Scope equipped with a 360 degree, swivel eye piece may be used on any horizontal spindle machine. This applies to jig borers, milling machines, and boring mills. For jig borer use, in locating V blocks and thereon centering any circular shaped workpieces, Center Scope locating is entirely and dependably exact. Additional information about Center Scopes and their numerous serviceable accessories is available on request, or use our

INFORM-A-GRAM KEY No. 585-N

HY-TEN SPECIAL STEELS. A century of experience in the development and application of special steels is being celebrated by Wheelock, Lovejoy & Co., Inc. They have published a booklet giving an interesting history of the company from the time it was formed in 1846 until the present. Photographs of members of the organization, and their numerous warehouses are shown. Due to their high degree of specialization in alloy and special steels, they were in a position to render exceptional service to manufacturers of guns, tanks, arms, ammunition, airplanes and machinery during the war. WHEELOCK, LOVEJOY & CO., INC., Dept. DJ, 138 Sidney St., Cambridge 39, Mass., will send booklet on request.

INFORM-A-GRAM KEY No. H8-N

DELTA GRINDERS set new standards for accuracy, sturdiness and dependability. A Delta motor, equipped with sealed-for-life ball bearings and requiring no lubrication for the entire life of the bearings, is enclosed in the heavy cast iron frame. A recent feature is the two manual brakes built into the head so the grinder can be slowed down and immediately stopped for reversing. Another new feature is the new labyrinth type bearing seal built in the carbide grinder to prevent coolant from washing out the bearing lubricant. This water-repellent lubricant is placed in the labyrinth space when the machine is assembled at the plant. A folder, giving specifications, is available from THE DELTA MANUFACTURING COMPANY, Dept. DJ, 613-D East Vienna Ave., Milwaukee, Wis.

INFORM-A-GRAM KEY No. 51-N

CRATEX is a modern rubberized abrasive for every use. These abrasive wheels and points are fast cutting, long lasting, and give a fine polish. To secure a bulletin giving the sizes, grades and prices of Cratex wheels, points, cones, ring buffs, etc., write CRATEX MANUFACTURING COMPANY, Dept. DJ, 81 Natoma St., San Francisco, Calif., or use our

INFORM-A-GRAM KEY No. E21-N

METAL CUTTING TOOLS are fully described and illustrated in a 2-color booklet by Haynes Stellite. Instructions on how to make tipped tools by bronze brazing and by silver alloy brazing are given, as well as information on hand and machine grinding. There are tables showing recommended cutting angles, speeds, and feeds for turning, boring, and milling operations. Copies can be secured from HAYNES STELLITE CO., Unit of Union Carbide and Carbon Corp., Dept. DJ, Kokomo, Ind.

INFORM-A-GRAM KEY No. 313-N

THE MECHANICAL HAND, incorporated into the Heyman Semi-Automatic Feeding Machine, assures absolute safety for the punch press operators hands particularly on secondary operations. The other advantages of increased production and decreased expense due to smashed dies and cracked presses are fully explained in a 4-page folder prepared by COVERT MFG. CO., Dept. TJ, Troy, N. Y.

INFORM-A-GRAM KEY No. D66-N

ADAPTING THE SHANK OF A DIE SET, to fit the opening in the ram of a punch press, is explained in a bulletin issued by HPL Manufacturing Co. The shank adaptor unit is split in two parts to give maximum clamping action, but two wire springs, fitted in machined grooves, hold the two parts together for ease of handling and storing.

Copies of Bulletin SA-100 will be sent on request to HPL MANUFACTURING CO., Dept. TD, 2013 East 65th St., Cleveland 3, Ohio.

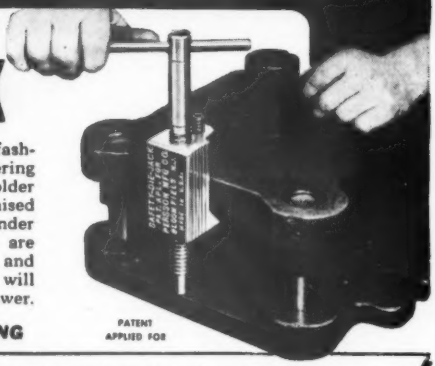
INFORM-A-GRAM KEY No. J1-N

A NEW TYPE OF WELDING ROD that has solved tough war-time welding problems, now available for peace-time production, is described in Eutectic Welder, special war production review issue.

NOW YOU CAN SEPARATE AND ASSEMBLE DIE SETS..QUICKLY..EASILY..SAFELY!

with a PERSSON

DIE JACK



These Die Jacks eliminate old-fashioned, unsafe, prying or hammering methods. Just clamp on punch holder and turn handle. Punch holder is raised or lowered smoothly, always under control. PERSSON Die Jacks are precision built from fine steel and alloys—a tool every tool maker will want for his tool box or bench drawer.

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PATENT APPLIED FOR

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AUTOMATIC

Tap Protection

Reduce Tap Breakage and Damage By Using A Procunier Tapping Head

The new Procunier sensitive high-speed tapping head allows fast, accurate tapping with a minimum of tap breakage. Driving power to the tap is automatically regulated by pressure applied to a special clutch. This clutch engages the conical surfaces of the drive and reverse shells, driving the tap with a soft "cushioned" action, practically eliminating tap breakage. Operators can quickly detect dull or loaded taps by the "feel" or pressure required to drive them—also, the clutch instantly slips, should the tap strike bottom or stick. ***Send coupon for circular giving full details, specifications and prices.***

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A new practical tap holder with many advantages. A broached section of the chuck receives the flattened surfaces on the spring collet, while the tap has a positive drive through the square hole broached in the collet. The tap is always in true alignment—tap shanks are never scored or "chewed up."

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Copies of this issue are available by writing EUTECTIC WELDING ALLOYS CORP., Dept. TD, 40 Worth St., New York 13, N. Y.

INFORM-A-GRAM KEY No. 81-N

A FEW OF THE MANY TYPES OF CUTTING TOOLS, made to special specifications, are illustrated in Bulletin-301 issued by American Cutter and Engineering Corp. A combination of machinery and equipment, trained operators, skilled technicians, rigid inspection, plus a firm insistence on quality assure customers that ACE special tools will produce precision products.

Copies of this bulletin will be sent on request from the AMERICAN CUTTER and ENGINEERING CORP., Dept., TJ, Warren, Michigan.

INFORM-A-GRAM KEY No. 639-N

MACHINING DRIVING SLOTS AND COUNTERBORES is now facilitated by two new extra heavy fly cutters introduced by the New-Field Machine Parts Co. Four removable high-speed or carbide bits are used, which provide stock milling cutters with a wide variety of applications without the necessity of having many special cutters on hand.

The application of these cutters is described and illustrated in literature available from NEW-FIELD MACHINED PARTS CO., Dept. TJ, 549 Randolph St., Chicago, Illinois.

INFORM-A-GRAM KEY No. A54-N

RAPID READING OF SURFACE TEMPERATURES by means of portable pyrometers is described in a new 12-page Bulletin No. 194-SA, issued by CAMBRIDGE INSTRUMENT CO., INC., Dept. TJ, 3112 Grand Central Terminal, New York 17, N. Y. Thirty-three illustrations show the use of the Roll Pyrometer on a wide variety of production operations; determining the temperatures of rolls or other convex surfaces; Mold Pyrometer for mold cavities; and Needle Model for measuring subsurface temperatures.

For copies of bulletin write the company.

INFORM-A-GRAM KEY No. 774-N

TRIPLED PRODUCTION for one company through the use of carboloy-tipped twist drills is information revealed by Nelco Tool Co. Faster cutting of plastics, ceramics, cast iron and bronze is possible, and because carboloy-tipped tools withstand such abrasive substances they do not dull rapidly. Nelco drills are ground to suit the material to be cut, thereby increasing their efficiency.

Descriptive literature is available on request from NELCO TOOL CO., INC., Dept. TJ, 370 Hamilton Ave., Brooklyn, N. Y.

INFORM-A-GRAM KEY No. E72-N

FOUR WELDERS IN ONE. The Universal Spot Welder No. 310-AA, offered by Eisler Engineering Co., will handle spot welding on all types of sheet metal work, as well as being usable with hand operated push type and tong type gun welders, and for ac arc welding. The machine can be supplied either with mechanical or all electronic type timer and contactor.

Literature giving details of this equipment is available from EISLER ENGINEERING CO., Dept. TD, Newark, N. J.

INFORM-A-GRAM KEY No. 278-N

POLISHING ODD-SHAPED PARTS of copper, brass, aluminum, zinc, magnesium and plastics, as well as steel, can be accomplished on a high production basis with the Crozier Vacuum-Grip Polishing Lathe. Catalog 2-44 describes and illustrates various Crozier polishing lathes in collet, chuck, and vacuum grip models. Write CROZIER MACHINE TOOL CO., Dept. TJ, 684 No. Prairie Ave., Hawthorne, Calif.

INFORM-A-GRAM KEY No. 255-N

PNEUMATIC OPERATING EQUIPMENT FOR DRILL PRESSES increases production and reduces costs. The use of the foot control leaves both of the operator's hands free, resulting in faster loading and unloading of fixtures. The operator presses the foot valve pedal and the predetermined air pressure enters the upper chamber of the air engine, which moves the spindle downward. While the foot pedal is held down the drill continues to descend. When the pedal is released, the air is exhausted from the upper chamber of the air engine through the exhaust valve, and simultaneously line air pressure is valved to the lower chamber of the air engine. The air engine then immediately moves the spindle upward, clear of the work so the next piece can be placed in drilling position. Bulletin DC-28, giving complete details, may be obtained from NATIONAL PNEUMATIC CO., Dept. DJ, 420 Lexington Ave., New York 17.

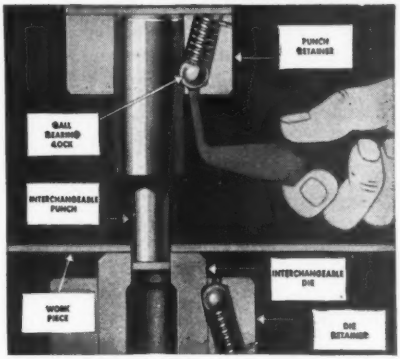
INFORM-A-GRAM KEY No. G71-N

SHORT LENGTH SCREW MACHINE DRILLS are of the proper overall and twist lengths; thus the costly and wasteful process of cutting off, resharpening and otherwise adapting full length drills to fit machines is eliminated. Web thickness, degree of spiral and flute contour are correctly proportioned to provide ease of penetration and chip clearance. They are available in fractional sizes $\frac{1}{16}$" to 2", in wire gage sizes 1 to 60, letter sizes A to Z, in both right- and left-hand cut. An illustrated circular may be requested from WHITMAN & BARNES, Dept. DJ, 2108 W. Fort St., Detroit 16, Mich.

INFORM-A-GRAM KEY No. 502-N

The Original

INTERCHANGEABLE PUNCH and DIE



Allied's R-B Interchangeable Punch and Die lowers costs in the metal working and plastic industries. Standard punches and dies carried in stock. Special shapes and sizes in any material made to your specifications with prompt deliveries. Send for large illustrated R-B catalog, now.

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SWAGING MACHINES, the subject of catalog SM, are fully explained by STANDARD MACHINERY CO., Dept. T-8, Providence 7, R. I. Included herein are complete details related to their regular line of swagers for pointing and sizing. Among the others are new Cable and Hydro-Former swagers which have so materially aided in establishment of wartime production records for metal shaping and the attachment of bar, cable, and tube fittings. In addition to informative line drawings, catalog SM also contains numerous photos of the swagers and their products.

INFORM-A-GRAM KEY No. F30-N

SWEDISH LIDKOPING HIGH POWERED CENTERLESS GRINDERS, and an assortment of parts ground on them, are illustrated and described in Publication 1516E issued by Lidkoping Machine Works. A feature of this grinder is the special spindle carrying two wheels, which makes it possible to grind simultaneously 3 diameters, 1 taper, and one shoulder and hold the tolerances to .0008".

This bulletin is obtainable from the American Agents, TRIPLEX MACHINE TOOL CORP., Dept. TJ, 125 Barclay St., New York, N. Y.

INFORM-A-GRAM KEY No. 497-N

INDUSTRIAL SAFETY EQUIPMENT. Literature is available from the Safety Division of AMERICAN OPTICAL CO., Dept. DJ, Southbridge, Mass., describing their safety goggles and various types of gloves. Their Duralite chemical goggles have greatly improved eyecups and indirect ventilation to minimize fogging. They have coated fabric gloves to protect hands against chemicals, mitts for heavy die casting operations, leather mittens for hot or cold chipping, steel studded mittens for steel workers, and many other types. They also carry a line of welding helmets, respirators, etc.

INFORM-A-GRAM KEY No. H91-N

SPOT WELDING NON-FERROUS METALS, WIRE, JEWELRY and steel up to 16 gauge is explained in a bulletin issued by Davis and Murphy. The bulletin describes their new USP-7½ Air Operated Midget Bench Type Spot Welder. This is a plug-in type, with solenoid valve control of air cylinder, and pressure switch. Copies can be obtained by writing DAVIS & MURPHY, Dept. TJ, Davis Bldg., 5252 Broadway, Chicago 40, Illinois.

INFORM-A-GRAM KEY No. D68-N

MADISON-KIPP LUBRICATORS, Models SV and SVH, are explained in Bulletin L-3501, a publication of MADISON-KIPP CORPORATION, Dept. T-5, Madison 4, Wis. Model SV is recommended for pressures of up to 100 lbs; Model SVH for pressures of over 100 lbs. Liquid sight feeds may be applied in one of three types: one for pressures of up to 100 lbs, another for pressures of up to 1,000 lbs; and a third for pressures of over 1,000 lbs. Like all Madison-Kipp reservoir-type lubricators, Model SV may be had with right- or left-hand rotary or reciprocating drive on the ends, sides or bottom of the reservoir. Upon application, there are available complete engineering data sheets which are tabulated to show the dimensions for the various lubricator sizes.

INFORM-A-GRAM KEY No. B86-N

SAFE, FAST CUTTING-OFF; straight and contour cutting; side cutting; cleaning and finishing with BAYFLEX grinding wheels is described and illustrated in a four-page folder recently prepared by Bay State. Increased flexibility of these wheels has been developed by combining aluminum oxide abrasive with cotton fibres, the degree of resilience being determined by the particular combination of abrasive, bond and wheel dimensions.

Copies of this folder can be obtained by writing BAY STATE ABRASIVE PRODUCTS CO., Dept. TD, Westboro, Mass.

INFORM-A-GRAM KEY No. 205-N

MAKING ELECTRIC FURNACE ALLOY STEEL is pictorially described in a bulletin, entitled Timken Alloy Steel, which shows the equipment for melting, soaking, rolling, piercing, finishing and inspection of alloy bars and seamless tubing.

For a copy of this bulletin write THE TIMKEN ROLLER BEARING CO., Dept. TD, Steel & Tube Div., Canton, Ohio.

INFORM-A-GRAM KEY No. 573-N

ABRASIVE CUTTING of practically any material, up to 2½" dia into lengths up to 16", is described in a bulletin recently issued by Campbell. Finishing operations are eliminated because smooth cut ends with parallel cuts to close tolerances can be produced on a top production basis. Their Model 725, with oscillating head, "is illustrated and its performance compared with Model 700 Autocutter.

For a copy of Bulletin DH-1315 write ANDREW C. CAMPBELL DIV., AMERICAN CHAIN & CABLE CO., Dept. TJ, Bridgeport, Conn.

INFORM-A-GRAM KEY No. 185-N

CENTER FINDER DEVICE will accurately locate the spindle of jig borers, milling machines, boring mills, drill presses, etc., in the exact center of a hole, plug or jig button. The operation is performed while the spindle is rotating at the same speed and conditions that will prevail when the hole is actually bored. It takes only a minute to locate the center of a hole within .0002". The indicator is mounted so the operator can hold it stationary while the spindle rotates the feeling finger. PRECISION GAGE & TOOL CO., Dept. DJ, 320 E. Third St., Dayton, Ohio, will send descriptive literature upon request.

INFORM-A-GRAM KEY No. H93-N

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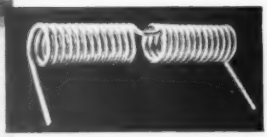

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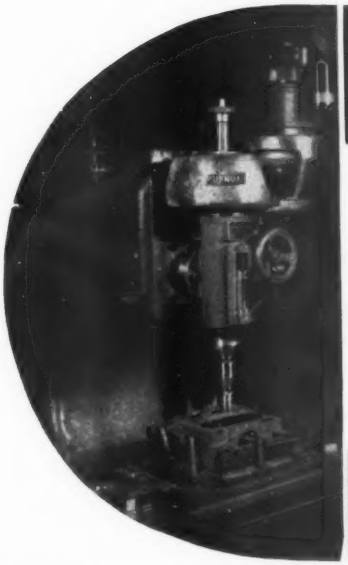

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Photo shows Rusnok head used to convert an old type milling machine into high speed, versatile, productive equipment. Uses many types of cutters on a wide range of work. Easily mounted—tilts to any angle. Large size spindle (No. 9 B & S taper). Takes $\frac{1}{16}$" to ¾" end mills. Large quill with 4" travel, counter balanced, hardened and ground. Six speeds 250 to 3000 RPM. Lever and worm feeds. ½ h.p. motor. Specially engineered by RUSNOK to meet modern demands for high speed, high precision, heavy duty end mill operations.

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PUBLICATION PREVIEWS

PEACE-TIME USE OF "DIE-LESS DUPLICATING" DEVELOPMENTS, made during war years, is summarized in the new Di-Acro Catalog No. 46-10, just released.

As the name implies, duplicate parts are produced without the benefit of dies. The Di-Acro System utilizes a shear, brake, and bender, whose construction and operation are described and generously illustrated. The bender will create shapes and outlines impractical or impossible to obtain at all with regular production dies. Contour forming covers all types of ductile materials such as round, half round, hexagon, and square rod, tubing, angle, channel, moulding, strip stock and bus bar.

Copies of this 40-page catalog are available from O'NEIL-IRWIN MANUFACTURING CO., Dept. TJ, 315 8th Ave., S., Minneapolis 15, Minn.

INFORM-A-GRAM KEY No. 20-N

CUTTING SHAFT KEYWAYS QUICKLY, with the W-1 Keyway Cutter, is described and illustrated in a folder issued by La Salle Sales and Manufacturing. The keyway cutting operation can be performed either with the cutter clamped in a vise, or the cutter mounted on the shaft while it is in place. Tightening two holding set screws automatically centers the shaft, and manually operating a hand lever actuates the keyway cutting tool. The width of keyway is controlled by width of cutting tool and the depth by a hand control feed screw.

For complete information on this keyway cutter write LA SALLE SALES AND MANUFACTURING, Dept. TJ., Book Building, Detroit 26, Michigan.

INFORM-A-GRAM KEY No. 15-N

FASTER FINISHING with Midget Mills and chatterless countersinks is explained in No. 15 catalog recently issued by Severence Tool Industries. In addition to the numerous sizes and shapes of midget mills in their regular line, several new tools are listed. These are solid Tube Deburring Cutters, Ball Seat Reamers, Edging Mills, and Electrode Dressing Cutters.

Copies of this catalog are available on request from SEVERENCE TOOL INDUSTRIES, INC., Dept. TJ, Box 850, Saginaw, Mich.

INFORM-A-GRAM KEY No. 461-N

STURTEVANT SENSORY TORQUE WRENCHES permit the measurement of preset torque by sight, sound and feel. When the pre-set torque is reached, the sensory mechanism sounds a loud and distinct click and imparts a definite strong impulse to the hand. The applied torque can also be read on dials which are readable from all working angles. A bulletin is available from P. A. STURTEVANT CO., Dept, DJ, Addison, Ill.

INFORM-A-GRAM KEY No. 479-N

NON-CORROSIVE RUST REMOVER is scientifically compounded to thoroughly wet metal, to rapidly dissolve rust and scale, completely remove it, and even under long exposure, to be relatively non-corrosive to steel. Non-Corrosive Rust Remover is available from NOX-RUST CHEMICAL CORPORATION, Dept. DJ, Chicago 8, Ill. Even after 8 hours' immersion in this remover, weight losses of less than 1/20th of 1 percent were shown by highly polished roller bearings when they were laboratory weighed with .0001 gram accuracy. Without leaving any perceptible etching or surface discoloration, this remover disposes of ordinary rust within seconds. Available in from pint to tankcar quantities, Non-Corrosive rust remover may be applied by brush, spray, and dipping. Because of the remover's rapid though lasting effectiveness in otherwise inaccessible crevices, dipping is its most economical use whenever practical. Non-Corrosive rust remover is also valuable for eliminating rust on castings, steel stock, fabricated parts, hand tools, periodically idle farm and process equipment, sporting goods, etc.

INFORM-A-GRAM KEY No. G74-N

SUTTON COLLETS AND FEED FINGERS for automatic and hand screw machines, lathes, and milling machines are illustrated and described in a new catalog, No. 16. These collets feature exclusively the diamond grip action which gives a tighter grip with less chucking strain and less wear on the collet, thus reducing spoilage due to slipping. The compressed spring principle which permits equalized and direct gripping pressure of the Super Feeders is also described. THE SUTTON TOOL CO., Dept. DJ, Sturgis, Mich., will send this catalog on request.

INFORM-A-GRAM KEY No. H82-N

TAPERED MILLING CUTTERS are made with 3 flutes which guarantee a fine finish with no chatter or flutter at high speeds. They are ground with a gradually increasing backoff toward the small end which gets rid of chips faster and gives freer cutting. Six tapers are supplied; ½°, 1°, 2°, 3°, 5°, and 7°. Small end sizes range from ⅛" to ½" with flute lengths from ½" to 3¼". Complete specifications are obtainable from DETROIT MOLD ENGINEERING CO., Dept. DJ, 6686 E. McNichols Rd., Detroit 12, Mich.

INFORM-A-GRAM KEY No. 264-N

MIDGET PUMPS AND LABORATORY STIRRERS are described and illustrated in a new catalog which is available from EASTERN ENGINEERING CO., Dept. DJ, New Haven, Conn. Most of the new models for regular industrial use and the special types recently developed are equipped with either adjustable stuffing boxes or mechanical rotary seals. The various models and types will immediately suggest numerous uses.

INFORM-A-GRAM KEY No. 652-N

MEASURING A PLUG GAGE WITH LIGHT WAVES

using an optical flat, a toolmakers flat and a gage block

The formula is:

$$D = h + \left(.000012 \times N \times \frac{W}{w}\right)$$

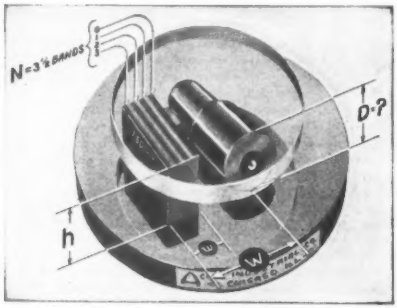
Substitute the actual values

$$D = .750 + \left(.000012 \times 3\tfrac{1}{2} \times \frac{1\ 7/16''}{23/64''}\right)$$

and get the answer

D = .750168 inch.

It's just that simple!



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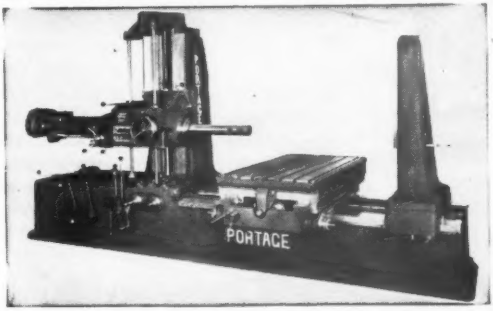

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Positive, Dependable Repeat Readings

When measuring outside diameters it frequently becomes advantageous and time saving not to have to move the items to be checked. The weight of the items or the set-up in the machine may make it inconvenient. To enable checking at the machine we have produced the Mikrosnap which consists of Mikrokator Number 220 with a scale range of .006 and graduated in .0001 set in snap gage frames. For those desiring a closer reading a scale range of .0024 graduated in .00005 can be had. Mikrokator Number 220 is interchangeable in 5 different frames with ranges of two inches to each frame, making a total diameter of 0 to 10" capable of being checked. It can be set direct with Johansson Gage Blocks to any desired size, thus giving direct reading instead of "feel" as with snap gages.

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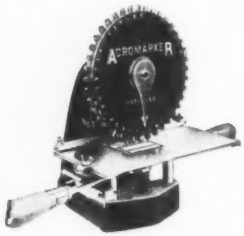

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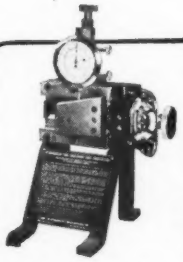

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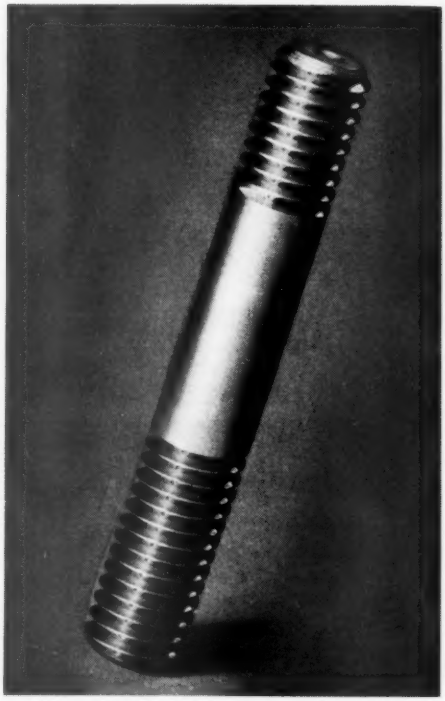

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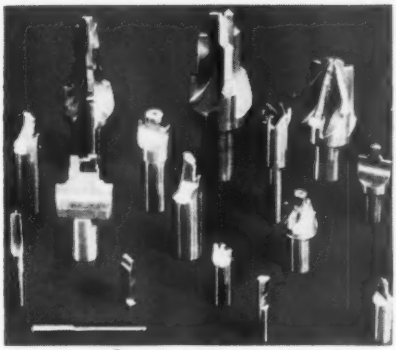

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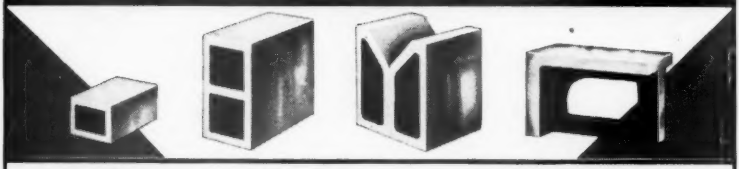

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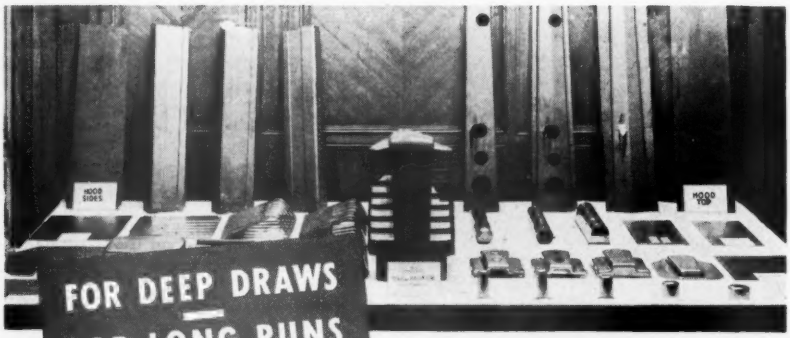

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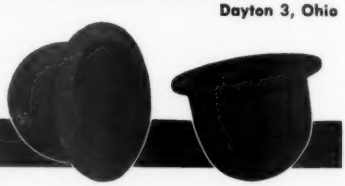

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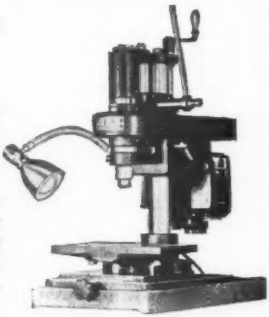

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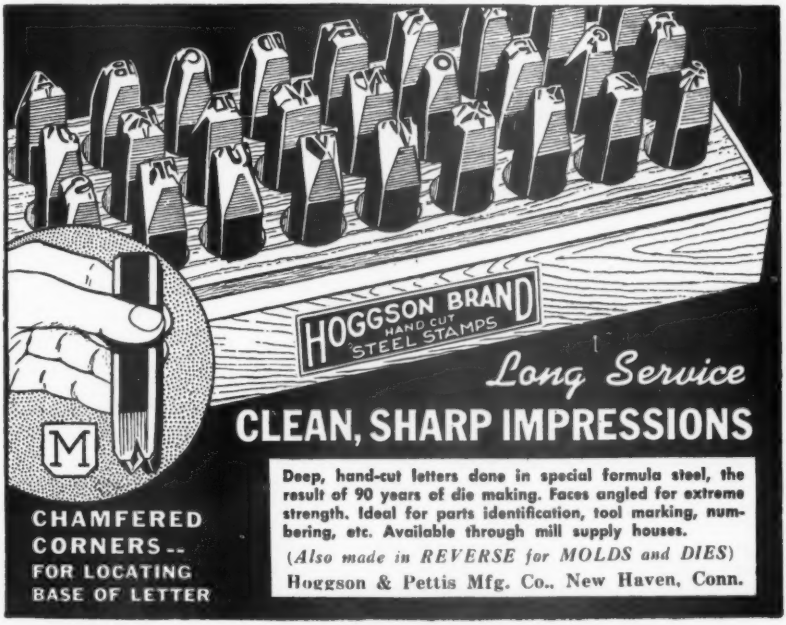

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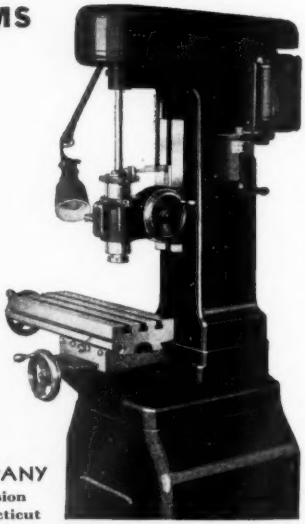

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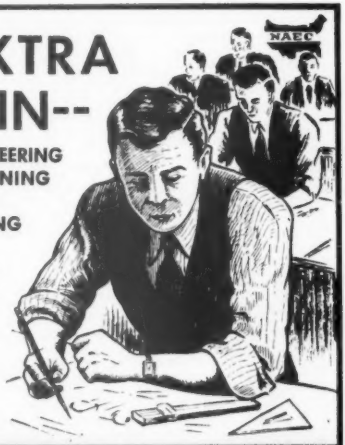

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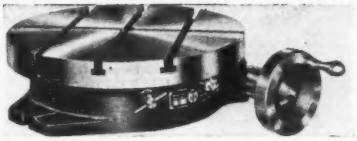

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For Tool, Die, Pattern or Template layout on metal . . . Quick identification of stock and parts . . . Shows up in sharp relief—dries instantly—easily removed . . . Write for circular.

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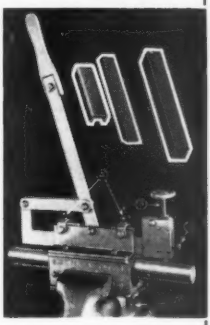
Cut a Perfect Keyway in Less Than Five Minutes
—With the New Portable Hand Powered W-1 Keyway Cutter

Cuts shaft keyways any length, width or depth.
Shaft automatically centered.
Takes shafts up to 2 1/8" diameter.
Cuts new splines or recuts old ones.
Cuts keyways to replace Woodruff keys.
Cuts can be made on the end—or any place along shaft.
Cuts can be made on a shaft in place. Tool will hold itself for cutting on a fixed shaft without the use of a vice.
Bits, finest tool steel, 1/4", 3/8" furnished with tool.
Finest material and workmanship. Wear points have compensating micrometer adjustments, to insure a lifetime of perfect service.



W-1 Keyway Cutter

Retail Price $39.75, Prepaid
Sold Through Jobbers
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WITH THE AERO MICROMETER STOP COUNTERSINK

Here's What This Versatile, Dependable Tool Will Do For You:

ALL PURPOSE: countersinks and counterbores, both in metal and in plastics.
ACCURATE: accurately limits depth of cut, regardless of surface variations.
PREVENTS BUCKLING: eliminates buckling troubles in countersinking sheet metal.
TOUCH CONTROL: finger-tip pressure adjusts depth in increments of .001, without removing tool from drill press.
AUTOMATIC LOCKING: no accidental adjustment, absolute uniformity of cutting depth.
HAND OR MACHINE: designed for efficient use in either hand tool or drill press.
LOW COST: $7.25, without cutter. Cutters (HS), $1.75.
IMMEDIATE DELIVERY: your order filled by return mail.

AERO TOOL COMPANY BURBANK, CALIFORNIA

TO SAVE YOUR TIME CLIP AND MAIL.

Accept my order for ..... Aero Micrometer Stop Countersinks.
Specify cutter angle ..... Pilot dia. .....
Please send me free, illustrated brochure.
Name ..... Title .....
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MILLING MACHINES

No. 4 Motor Driven MILLING MACHINE Mounted on Cabinet Column

Burke motor driven milling machines Nos. 1, 2, 3, and 4 are specially suited for handling small, difficult work on a production basis.

Write for complete information.

Burke Machine Tool Co.

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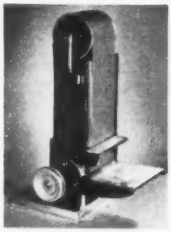
THE WOODS MODEL 40 BELT SANDER



A Husky Little Sander Able To Do A Wide Variety Of Jobs Performed On Larger, More Expensive Machines

Check These Superior Features

Bearings—Heavy duty New Departure dust sealed ball bearings throughout.

The only small sander with drive shaft supported on both ends of the shaft for longer bearing life and smoother operation.

Capacity—platen work area 5" x 8½" larger than any machine using a 36" belt.

Reversible platen—either face of platen can be used thus assuring a continual flat work surface.

Tool Grinder—a small rest for grinding tools is supplied.

Two positions—light weight of machine makes it easily operated in either vertical or horizontal position.

Pulleys—large weight aluminum 4" x 4½" to increase life of belt.

Positional platen 4" x 6"—adjustable to any angle.

Belt Tracking and tension are accomplished with simple thumb screws.

Shafting—supporting moving parts is ⅝" diameter and piston ground.

SPECIFICATIONS:

Standard Abrasive belt—4" x 35".
Bench Space—9" x 15".
Motor recommended—⅓ h. p.
Net Weight approximately 17½ lbs.
Shipping Weight—approximately 22 lbs.
Shipped F.O.B. our South Norwalk plant.
Standard equipment includes two working dams, the new reversible work platen, and 3 sanding belts in grits #80, #120 and #180.

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MILL IT ON YOUR LATHE

WITH A **PALMGREN**

MILLING ATTACHMENT

Now — you can do milling, slotting, grinding, grooving, squaring shafts, sawing at angles, and many other important operations on your lathe. PALMGREN MILLING ATTACHMENT is a necessary fixture for small shops, schools and emergency work in large plants. Fits South Bend, Atlas, Craftsman, Logan, Sheldon and all other makes. It has 360° graduation for rotary angle adjustments, also graduated feed and adjustment screw. Easily mounted by straddling lathe's regular tool post. Try one—it will quickly pay for itself.

No. 350

IMMEDIATE DELIVERY

Nos.	Width Jaws	Depth Jaws	Jaws Open	Weight Pounds	Base Opening	Price F. O. B. Factory
150	1⅛"	1"	1⅛"	6½	1"	$18.75
250	2⅛"	1 7/16"	2½"	11	1¼"	24.75
400	4"	1½"	4"	25	2"	39.75

Order from your dealer or jobber.
Write for circular No. 350.

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Mfrs. of PALMGREN PRODUCTS for Over 25 Years

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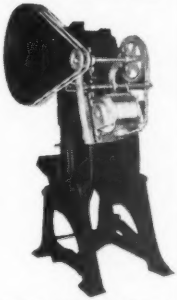
MODERNIZE

with

"Modern Motor Drives"



Direct drive units available for practically every type and model machine tool. Save floor space, power, and lineshaft expense. Moderate Cost. Prompt Delivery.

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The Nichols Engineering Company
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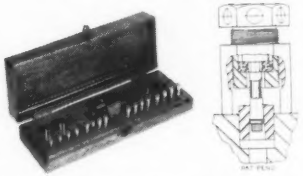
Dept. MD

It's New!



The Bolduc Extractor permits removal of pierce die inserts from dies without removing die from press or sections from dies.

These extractors have been engineered and developed to do a job in a manner not possible before.

In addition to pulling pierce die inserts, it may be used on ball bearings, sleeves, liners, etc., the merit of this tool has been proven by the many users in the field.

We solicit your extractor problems and assure prompt attention to inquiries.

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Use Chicago Rawhide

HAMMERS and MALLETS

C/R hammers have malleable iron heads with replaceable coiled rawhide faces.

When hammers and mallets must take stern punishment in long, hard service . . . when they must give forceful blows with maximum protection to fine finishes and expensive machined parts . . . it will pay you to insist on *Chicago Rawhide.* Made from tough, resilient, carefully selected hides, C/R hammers and mallets won't crumble, split, mushroom or erase, and they hold their true striking surfaces. Rawhide protects . . . Chicago Rawhide protects most.

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You need low-cost
OPTI-LOCATOR!

OPTI-LOCATOR— Visually aligns reference marks to axis of spindle rotation.

- Corrects for spindle runout.
- Makes all locating problems simple, accurate, positive.
- Can be used on any machine tool for greater precision in boring, measuring or locating.

Write for Free Folder illustrating simple operation and many uses!

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Power Press **SAFETY GUARD** *with automatic counter Registers Each Stamping*

• Sweeps operator's hands aside on any downward stroke of ram. • Guard easily swings aside while making press adjustments. • Designed for all presses. 30 days' trial. Send for bulletin and prices!

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Drop Forged Carbon and Chrome-Vanadium open end and box socket wrenches, and Chrome-Vanadium Steel Detachable Sockets with drop forged Ratchets—over 100 types, all sizes.

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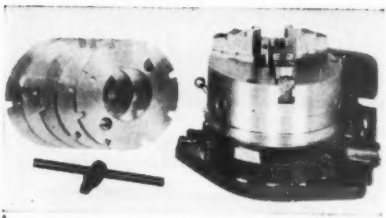

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Greater Speed With Accuracy

HARTFORD "SUPER-SPACER"

So many different jobs can be done more economically with the Hartford Super-Spacer that it will pay you to investigate its possibilities for your shop. Standard equipment includes mask plates, reversible jaw self-centering chuck, sliding handle chuck wrench. It's moderate in cost. Write for illustrated applications bulletin.

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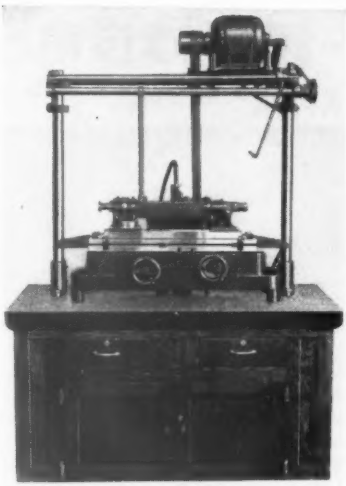
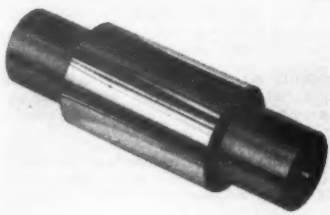




CRYSTAL LAKE 8" x 10" UNIVERSAL SPRING LOADED MOTOR DRIVE GRINDER has established leadership in small parts grinding.

Sample Grinding Gauge shown tests from three-quarter to one and one-quarter MICRO-INCH SURFACE FINISH. Roundness to .000005", Parallel to .00001".

UNIVERSAL will grind from 1/32" to 4½" swing over standard water guards on dead center grinding.

CRYSTAL LAKE GRINDERS

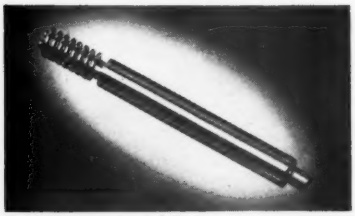
(Originators of Spring Loaded Motor Drives)

CRYSTAL LAKE, ILLINOIS

Since 1910

PRECISION PARTS

PRECISION IN THE NEWS



Here is an essential part of modern telephoto equipment—a motor shaft precision-made by Ace. One of the interesting features of this piece was the tiny drill rod insert ¼" long and 1/16" in diameter. It was formed, heat-treated, and centerless ground, and then press-fed into a 1/16" reamed hole at the end of the shaft.

RELY ON ACE FOR PRECISION GRINDING Centerless, Internal Cylindrical, External Cylindrical, Blanchard Surface, Plain Surface, and Thread Grinding.

PRODUCTION MACHINING Turning, milling, drilling, cutting, tapping, and threading of small machine parts that require precision grinding—on a mass-production basis.

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ACE
TRADE MARK

ACE MANUFACTURING CORPORATION
for Precision Parts
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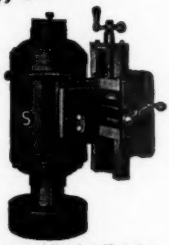
"RIGHT! YOUR MACHINE TOOL CAN NOW SERVE YOU AS A (STANDARD) GRINDER TOO."

YES SIR! You can now make your machine a "double purpose" machine, the "Standard Way". STANDARD VERTICAL SPINDLE GRINDERS can be easily mounted on your Planers, Boring Mills, Shapers, Milling Machines, etc., giving you added profits! Available with or without feeds as preferred.



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MIRROR FINISHES
in Minutes instead of Hours

On Tungsten Carbide, Tool Steels, Special Steels, Chrome, etc.

WITH STAR DUST

Laboratory Graded

Pure Diamond Powders and Diamond LAPPING COMPOUND

Produces super-finishes and polishes down to less than a MICRO-INCH with INCREDIBLE SPEED.

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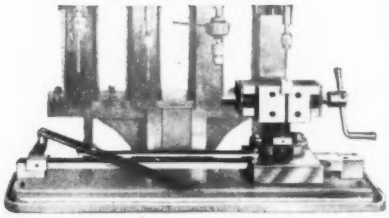
"JOHNS" DRILL JIGS

with the

SPLIT SECOND JIG ALIGNMENT
JIG CARRIAGE



NO RE-CHUCKING
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Drill & Tapping, Reaming or
Center Boring, etc., Operations

Send us your Jigging problems.

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Accurate Spacing- *by the Thousandths*

DE-STA-CO ARBOR SPACERS

Save time in setting up milling machine cutters, and wherever accurate spacing must be obtained and *maintained.*

Made of metal. Not only for greater accuracy, but also because they will not be affected by heat or oil. And can be used over and over. Standard sizes from .001" to .125". Specials, cut from bar stock, in any length and ground to decimal.

Order a set of De-Sta-Co Spacers from your Mill Supply Distributor today.

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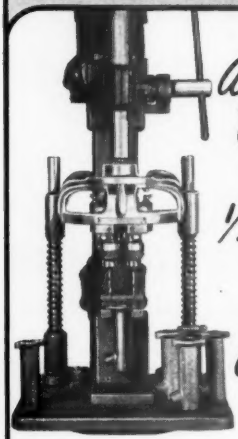
Established Over 30 Years
344 Midland Ave • Detroit 3, Mich.

TWO SPINDLE *Adjustable* DRILL HEADS

Drill Two Holes At Once



✓ *Adjustable Centers from 1/2" to 6"*

✓ *Drill Capacity 0" to 5/8"*

Sleeve and overarm types ... in several sizes. Will double output of any single spindle drill press.

Quickly adjusted to desired drill centers from 1/2" to 6".

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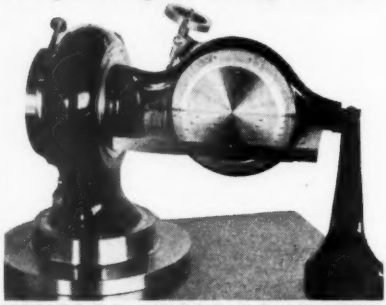
MACHINE & TOOL CO., INC.
12250 COYLE AVENUE
DETROIT 27, MICHIGAN

Compute Angles Quickly with the



STUDLER ANGLE COMPUTER

● **THE STUDLER ANGLE COMPUTER** so simplifies layout of die work, survey of castings, and inspection of precision-machined parts that users report it is doing the work in one-half to one-tenth of the time required by other methods. With this instrument, only one set-up of the work is required since its surface plate may be rotated 360 degrees in each of three separate directions of rotation: horizontally, vertically, and radially. A part having a number of angles and related angles may be surveyed in a few MINUTES. Model "A", Surface Plate 9" x 4½" x ½". Model "G" (shown above) Surface Plate 16" x 9" x 1". Write today for Bulletins No. 2 and No. 5.

THE ANGLE COMPUTER COMPANY
1709 Standard Avenue GLENDALE 1, CALIF.

PRECISION GRINDING AT COSTS EQUAL TO OR BELOW YOUR OWN SHOP OPERATIONS

Open Capacity Immediately Available

Let Practical Grinders Handle Your Grinding Problems

- Centerless to 9" diameters
- Internal from 1/8" up
- Cylindrical up to 16" diameter, 82" long
- Blanchard to 36" diameter
- Flat and cylindrical lapping

Sales and Service on Carborundum Abrasives
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UNIVERSAL GRINDING COMPANY
746 Woodland Avenue • Cleveland 15, Ohio

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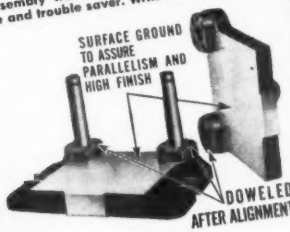
35 YEARS OF DIE SET MAKING

THE DIE-SET AUTHORITY

All Baumbach Die-Sets have demountable Leader Pins and Bushings. This exclusive feature permits removing leader pins for machine work on the die shoe and assures reassembly without loss of alignment. A big time and trouble saver. Write for Catalog.



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Seven warehouse stocks of rounds, flats, squares, hexagons, octagons. Forgings to specification.

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THOMAS-BARKER
Wrenchless
CHUCKS AND VISES

Save Time— PRODUCE MORE!

Easily Installed— No Accessories Required

Thomas-Barker Wrenchless chucks are made in 3-jaw (shown above) and 2-jaw types.

• Output by turrets, engine lathes, pipe threading machines, cutting off machines, drill presses, and other types of chucking machines, is greatly increased by the use of Thomas-Barker Wrenchless Chucks and Vises.

A pull on the lever grips the piece part with great power—a push on the lever releases the part. For many parts made on turrets, engine lathes, etc., it is unnecessary to stop the machine to set the work. The cycle of operation is simple and fast—reducing machine waiting time to the minimum.

Thomas-Barker Wrenchless vises are available in 3-jaw (shown below) and 2-jaw types.

Write today for new descriptive bulletin No. 201

THOMAS HOIST CO.
Chuck Division
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HIGH PRODUCTION AT LOW COST

REG. U.S. PAT. OFF.

HY-PRO TAPS

By threading more holes per tap you can increase your production and lower tapping operation costs with HY-PRO Ground Thread Taps.

These high production taps are scientifically produced to give longer, more accurate service, and longer wear between sharpenings.

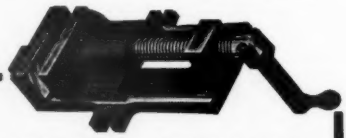
HY-PRO method of packaging makes crush-proof box a miniature tool box that fully protects taps and offers many time-saving advantages. Tension cover prevents spilling and injury to taps. Legible, informative labels are color-coded to save inventory time, and their position on cover prevents mixing of sizes when taps are returned to box.

PROMPT DELIVERY
Many special as well as standard taps in stock

COMMERCIAL
PRECISION
SPECIAL
Ground Thread Taps

Write for Catalog on Company Letterhead

HY-PRO TOOL CO.
New Bedford, Mass., U.S.A.



YOST DRILL PRESS VISE

This new Yost vise has been designed expressly for use on drill press operations. Does away with special and costly jig fixtures.

Offered in two sizes

Vise No.	Width of Jaw, Inches	Opens Inches	Weight Pounds
1D	3½	4	12½
2D	5	5½	23

Do you need a vise of ANY type?

Write today for bulletins on the extensive Yost line

YOST MFG. COMPANY
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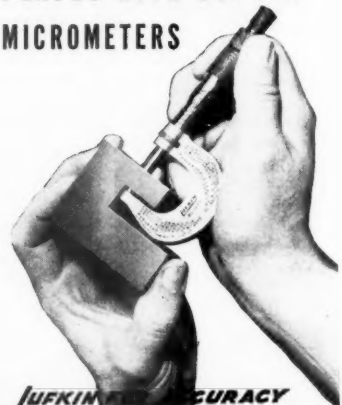
IT'S EASY TO MEASURE THOSE HARD-TO-GET-AT PLACES WITH LUFKIN MICROMETERS

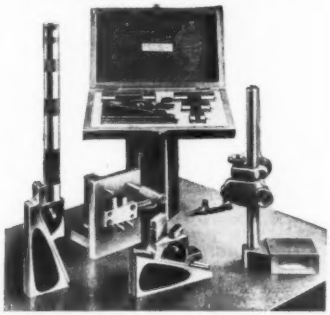


LUFKIN [illegible] ACCURACY
THE LUFKIN RULE CO., SAGINAW, MICH., NEW YORK CITY

A PRECISION CHECKING TOOL

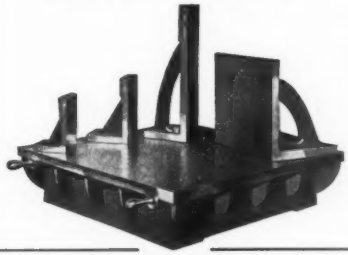
Parallel in all positions to .0001
Gauge is 1" thick, Standards 1" dia.
Over 16" high
Easy adjustment — Positive lock

Set this tool to your indicator reading, lock the adjusting nut, your reading remains the same. Write for further details.



Joseph B. Fakes & Company
ROYAL OAK, MICHIGAN

MILWAUKEE
Surface Plates



A full line of surface plates, angles and box parallels. Standard plate sizes from 8" x 8" to 48" x 96", larger sizes with or without legs. Plates are finish-planed and scraped to insure a very accurate surface.

Write for details.

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Engineers & Machinists Since 1907

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SOMETHING NEW IN 3-WAY PARALLEL SET-UP BLOCKS

One Handy Set Speeds Set-ups To 12 Different Heights

Set includes six each of two sizes: 1" x 2" x 3" and 7/8" x 1-1/4" x 1-1/2"

This handy, compact set of Moore 3-Way Parallel Set-up Blocks takes the place of a large number of conventional parallels. Each block may be used in any of its three dimensions to build up to 12 different heights.

Spaced *around* the work-piece to provide support, parallel or perpendicular to working surfaces, they eliminate sagging, localize stresses and hold work rigidly throughout the machining operation. And they may be placed to avoid interference with holes being bored or ground.

Moore 3-Way Parallel Set-up Blocks are carburized chrome-nickel steel, finish-ground to +.0002"-.0000". Sides are parallel within .0002". Write for descriptive literature.

MOORE SPECIAL TOOL CO., INC.
726 Union Ave. • Bridgeport 7, Conn.

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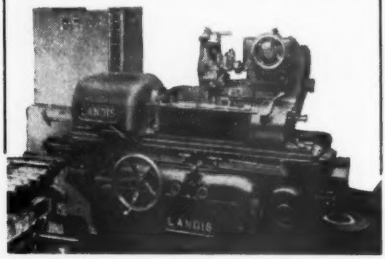
IMPROVE YOUR PROCESS OR INCREASE PRODUCTION?



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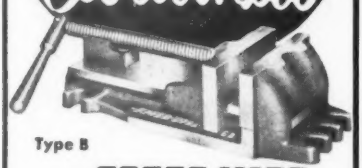

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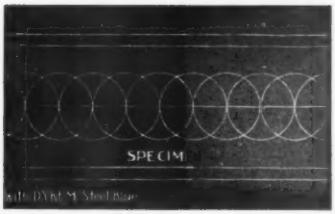

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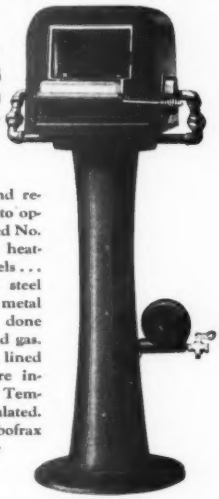

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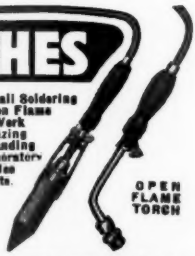
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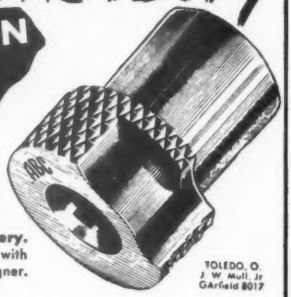

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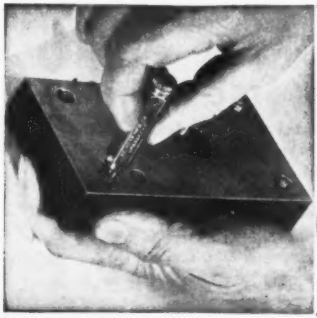

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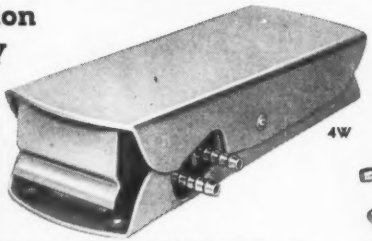
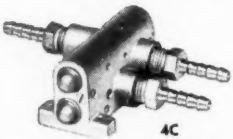


4W

4B



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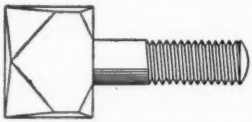

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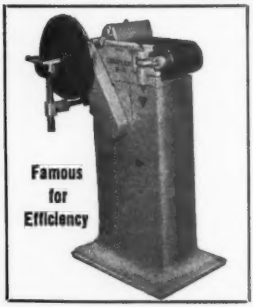

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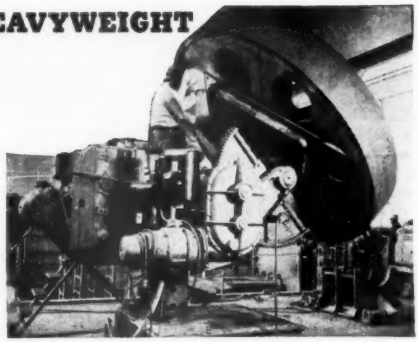

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"Unbrako"
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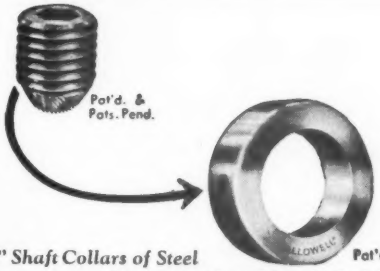

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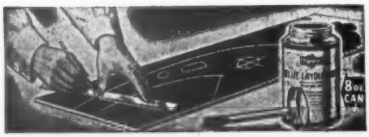

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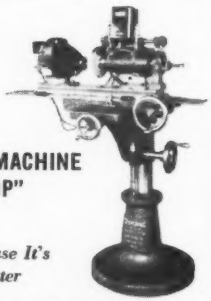

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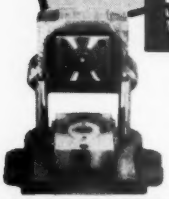

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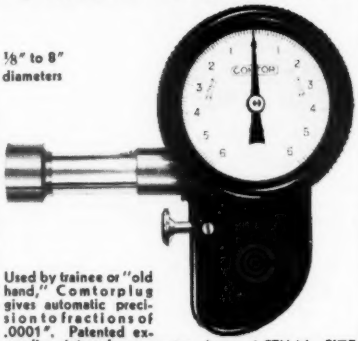

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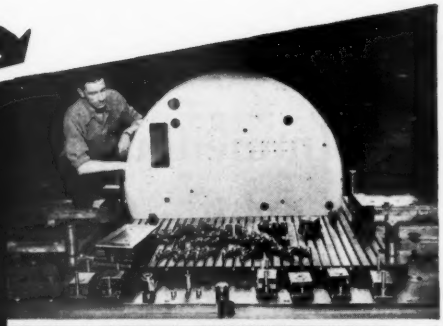
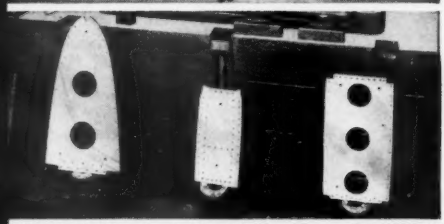


Re-use same WHISTLER ADJUSTABLE DIES in unlimited combinations



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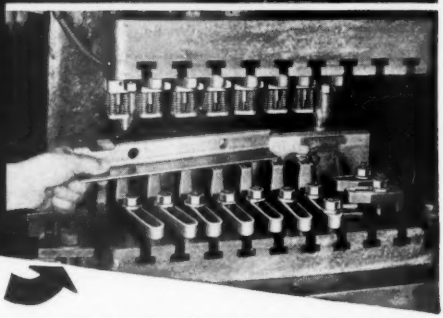

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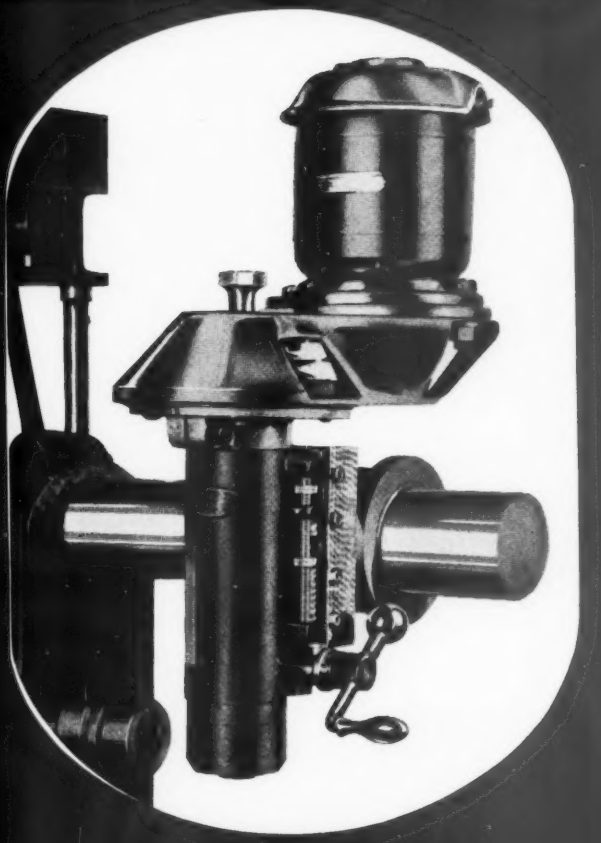

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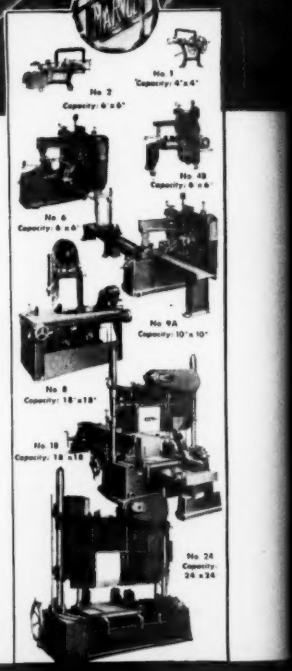

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